Report to Congress on the Discharge of Hazardous Wastes
to Publicly Owned Treatment Works EPA 530-SW-86-004

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United States
Environmental Protection
Agency

Office of Water
Regulations and Standards
Washington, DC 20460

February 1986
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Water

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Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works

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REPORT TO CONGRESS ON THE DISCHARGE OF HAZARDOUS WASTES TO PUBLICLY OWNED TREATMENT WORKS

(THE DOMESTIC SEWAGE STUDY)

February, 1986

U.S. Environmental Protection Agency
Office of Water Regulations and Standards
401 M Street, SW
Washington, DC 20460

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 7 1986

THE ADMINISTRATOR

Honorable George Bush
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to send you a copy of the Environmental Protection Agency's (EPA) Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Work's (POTW's). The Report is referred to as the Domestic Sewage Study and responds to Section 3018(a) of the Hazardous and Solid Waste Amendments of 1984 (HSWA).

Section 3018(a) requires that "the Administrator shall, not later than 15 months after the date of enactment of the Hazardous and Solid Waste Amendments of 1984, submit a report to the Congress concerning those substances identified or listed under Section 3001 which are not regulated under this subtitle by reason of the exclusion for mixtures of domestic sewage and other wastes that pass through a sewer system to publicly owned treatment works. Such report shall include the types, size and number of generators which dispose of such substances in this manner, the types and quantities disposed of in this manner, and the identification of significant generators, wastes, and waste constituents not regulated under existing Federal law or regulated in a manner sufficient to protect human health and the environment".

The purpose of the Domestic Sewage Study was to evaluate the impacts of waste discharged to publicly owned treatment works (POTW's) as a result of the Domestic Sewage Exclusion. The Domestic Sewage Exclusion, (specified in Section 1004(27) of RCRA) provides that a hazardous waste, when mixed with domestic sewage is no longer considered hazardous. Therefore, POTW's receiving hazardous waste in this manner are not subject to the RCRA treatment, storage and disposal facility requirements. The premise behind the Domestic Sewage Exclusion is that RCRA management of wastes within a POTW is unnecessary and redundant since these wastes are regulated under the Clean Water Act's regulatory programs.

In requiring the Agency to prepare this report, Congress is inquiring about the ability of the regulatory programs under the Clean Water Act, supplemented by other environmental statutes, to control the discharge of hazardous waste to POTW's for adequate protection of human health and the environment.

The report contains, along with an executive summary and introduction, a description of the types of hazardous waste included in the study; presentation of the types and numbers of industries that discharge hazardous waste to POTW's, as well as the types and amounts of hazardous waste discharged by these industries; an analysis of the fate of hazardous waste discharged to POTW's; the environmental and health effects of these discharges; and an analysis of the regulatory programs controlling these discharges.

The following is a summary of the key findings of the Report:

- POTW's have and will continue to have a major role in the disposal and treatment of waste containing hazardous constituents discharged by industrial facilities.
- Hazardous waste, as well as hazardous waste mixed with other wastewaters are typically the same wastestreams that are regulated under the pretreatment and the industrial treatment standards programs of the Clean Water Act.
- The study evaluated 47 industrial categories and identified approximately 160,000 industrial facilities that discharge wastewater containing hazardous constituents to POTW's. These facilities discharge an estimated 3.2 billion gallon per day of process wastewater.
- The study showed that the Clean Water Act's regulatory programs have made substantial reductions in the discharge of hazardous constituents to POTW's (approximately 95 percent of the metals and 50 percent of the organics). Continuation of these programs can bring about major, additional reduction of organics constituents.

- The study identified key areas where additional information is necessary for the continued evaluation of the Domestic Sewage Exclusion
- The study concluded that the Domestic Sewage Exclusion should be retained.

This study is a major contribution to the understanding of the relationship between the Clean Water Act, the Resource Recovery and Conservation Act, as well as other environmental legislation. Moreover, it underscores the importance of coordination at the Federal, State and local level.

We believe that the Report has addressed all the tasks mandated by the Congress, and the Report supports the continuation of the Domestic Sewage Exclusion. Because of the key role that POTW's have in the discharge and treatment of these wastes to their systems, the Agency will continue to evaluate municipal performance in controlling wastes received as a result of the Domestic Sewage Exclusion. We have already identified areas where additional information is necessary for this evaluation.

We anticipate that this information will be complex and require some time for analysis and evaluation. In addition, the Agency is committed to a regulatory development process, which because of its public participation and review requirements, also requires valuable time. While, we will make every effort to move as quickly as possible, I wanted to take this opportunity to inform you that we are concerned with meeting the 18 month promulgation requirements for additional regulations in Section 3018(b) of HSWA.

The study provides a sound and thorough summary of the discharge of hazardous wastes to POTW's. I believe it establishes a solid information base on this subject.

Sincerely,

Lee M. Thomas

Enclosure

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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Speaker, U.S. House of Represesentatives
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Sincerely,

Lee M. Thomas

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Enclosure

FOREWORD

This report was prepared by the Office of Water Regulations and Standards, the United States Environmental Protection Agency, with support from a contractor, Science Applications International Corporation (SAIC), on EPA Contract No. 68-01-6912. The EPA manager was Tom O'Farrell, and the SAIC managers were Peter Trick and Frank Sweeney. In addition, an EPA Work Group, comprised of members from the Office of Water, the Office of Solid Waste and Emergency Response, the Office of General Counsel, the Office of Policy, Planning, and Evaluation, the Office of Research and Development, the Office of Air and Radiation, the Office of Pesticides and Toxic Substances, the Office of External Affairs, and EPA Regions provided technical input and review.

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LIST OF ACRONYMS

ACGIH	American Council of Government Industrial Hygienists
AERL	Athens Environmental Research Laboratory
AMSA	Association of Metropolitan Sewerage Agencies
BMR	Baseline Monitoring Report
BPJ	Best Professional Judgment
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (Superfund)
CFCs	Chlorinated Fluorohydrocarbons
CFR	Code of Federal Regulations
CWA	Clean Water Act
DSE	Domestic Sewage Exclusion
DSS	Domestic Sewage Study
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FWPCA	Federal Water Pollution Control Act
GCA	Gulf Coast Authority
HSWA	Hazardous and Solid Waste Amendments
HWDMS	Hazardous Waste Data Management System
ISDB	Industry Studies Data Base
ITD	Industrial Technology Division
IUs	Industrial users
IWC	Instream wastewater concentration
kkg	Metric tons
MDSD	Monitoring and Data Support Division
mgd	Million gallons per day
MLVSS	Mixed liquor volatile suspended solids

LIST OF ACRONYMS (Continued)

MPRSA	Marine Protection, Research, and Sanctuaries Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
NRDC	Natural Resources Defense Council
NSPS	New source performance standards
OCPSF	Organic Chemicals and Plastics and Synthetic Fibers Industry
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OTA	Office of Technology Assessment
OW	Office of Water
PELs	Permissible exposure limits
PIRT	Pretreatment Implementation Review Task Force
POTWs	Publicly Owned Treatment Works
PSES	Pretreatment Standards for Existing Sources
RCRA	Resource Conservation and Recovery Act
RIA	Regulatory Impact Analysis
SDWA	Safe Drinking Water Act
SIC	Standard Industrial Classification
SIPs	State implementation plans
SQG	Small Quantity Generator
TLVs	Threshold limit values
TSCA	Toxic Substances Control Act

LIST OF ACRONYMS (Continued)

TSDF	Treatment, storage, and/or disposal facility
TSP	Total suspended particulates
TTO	Total Toxic Organics
U.S. EPA	United States Environmental Protection Agency
VHAPs	Volatile hazardous air pollutants
VOCs	Volatile organic compounds
WERL	Wastewater Environmental Research Laboratory

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report presents the results of the Domestic Sewage Study (DSS) performed by the U.S. Environmental Protection Agency in response to Section 3018(a) of the Resource Conservation and Recovery Act (added by the Hazardous and Solid Waste Amendments of 1984). This provision requires that EPA prepare:

> ... a report to the Congress concerning those substances identified or listed under section 3001 which are not regulated under this subtitle by reason of the exclusion for mixtures of domestic sewage and other wastes that pass through a sewer system to a publicly owned treatment works. Such report shall include the types, size and number of generators which dispose of such substances in this manner, the types and quantities disposed of in this manner, and the identification of significant generators, wastes, and waste constituents not regulated under existing Federal law or regulated in a manner sufficient to protect human health and the environment.

Within EPA, the Office of Water has accepted lead responsibility for preparing this report.

Purpose

The purpose of the DSS is to evaluate the impacts of wastes discharged to publicly owned treatment works (POTWs) as a result of the Domestic Sewage Exclusion (DSE). The DSE provides that a hazardous waste, when mixed with domestic sewage, is no longer considered a hazardous waste. The exclusion allows industries connected to POTWs to discharge hazardous wastes to sewers containing domestic sewage without having to comply with certain RCRA generator requirements, such as manifesting and reporting requirements. Moreover, POTWs receiving DSE wastes are not deemed to have received hazardous wastes and, therefore, are not subject to RCRA treatment, storage, and disposal facility requirements. Section 3018(a) directs EPA to ascertain how much hazardous waste is being discharged to sewers as a result of this exclusion, and whether existing regulations provide sufficient protection for human health and the environment.

Study Approach

Specifically, Congress requested a report containing information on:

- Types, size, and number of generators using the DSE
- Types and quantities of wastes disposed under the DSE
- Significant generators, wastes, and constituents not sufficiently regulated to protect human health and the environment.

In performing its source evaluation, EPA collected information on waste discharges from 47 industrial categories and the residential sector. The DSS analysis provides detailed loadings estimates for 30 selected industries covered under the consent decree negotiated between the National Resources Defense Council (NRDC) and EPA in 1976. EPA presently does not have sufficient data to characterize fully waste discharges by the remaining 17 industrial categories, although it appears, based on limited available data, that certain of these categories may be discharging significant quantities of waste.

After assessing the various data sources available for performance of the DSS, EPA adopted a technical approach that provides estimates for loadings of specific hazardous constituents (e.g., benzene, tetrachloroethylene, acetone, etc.) rather than generic RCRA waste types (e.g., spent solvents, electroplating baths, still bottoms, etc.). The Agency collected and evaluated discharge data for 165 selected hazardous constituents. Because of data limitations, the analysis provides more extensive estimates for loadings of priority hazardous constituents (i.e., those hazardous constituents that also are considered Clean Water Act priority pollutants) rather than nonpriority hazardous constituents. Generic hazardous wastes can include both priority and nonpriority hazardous constituents. More comprehensive assessment of hazardous waste discharges, then, is heavily dependent on the collection of additional data on discharges of nonpriority hazardous constituents to POTWs.

EPA was able to develop more detailed information on hazardous wastes, constituents, and management practices for the organic chemicals industry, using the Office of Solid Waste's Industry Studies Data Base (ISDB). DSS estimates of the quantity of hazardous waste constituents produced by the organic chemicals industry (and ultimately disposed to sewers) focused on the quantities of hazardous materials generated at the actual production process as its point of measurement. This method of estimating the quantities of hazardous wastes is significantly different from traditional methods of measurement used in the RCRA program, which consider not only the quantity of hazardous waste generated in the production process, but also account for any mixing of hazardous waste with nonhazardous materials as a result of their treatment, storage, and disposal. Nevertheless, use of a point of production approach for the DSS represented a valid methodology for the development and interpretation of constituent-specific data.

Furthermore, there is a fundamental lack of knowledge on the behavior and effects associated with many hazardous constituents. In particular, little is known about ground water contamination as a result of exfiltration from POTW systems or air emissions due to industrial discharges to sewers. Projections based on best professional judgments were used to overcome inadequate data where some information existed. Otherwise, gaps are documented to help guide future research.

The DSS report presents findings on the types, sources, and quantities of hazardous wastes discharged to sewers. The fate of hazardous constituents in POTW systems is examined and environmental effects are analyzed. The adequacy of existing government controls is evaluated. Major findings and recommendations in each of these areas are discussed below.

- Overview of Sources, Types, and Quantities of Hazardous Constituents Discharged to Sewers

  The DSS source assessment evaluated discharge data for 47 industrial categories and the residential sector, and identified approximately 160,000 industrial and commercial facilities discharging wastes that contain hazardous constituents. Together, these facilities discharge an estimated 3,200 million gallons per day of process wastewater, constituting approximately 12 percent of total POTW flow. The 30 selected consent decree industries discharge 62,000 metric tons per year of the hazardous metal constituents at raw discharge levels, and 3,300 metric tons per year of the hazardous metal constituents, assuming full PSES reductions. With full implementation and enforcement, categorical standards should produce a 94 percent reduction in metal constituent loadings from the consent decree industries.

These same industries discharge between 37,000 and 52,000 metric tons per year of the priority organic constituents at raw discharge levels, and approximately 20,000 metric tons per year of these constituents, assuming implementation of existing and proposed PSES standards. At projected PSES control levels, categorical standards will provide reductions in organic constituent loadings of between 47 and 60 percent. Relative contributions of metal and priority organic constituents from the residential sector will increase significantly following PSES implementation.

- Discharge of Nonpriority RCRA Constituents to POTWs

EPA currently lacks the data necessary to estimate fully the loadings of nonpriority RCRA constituents from most industrial categories. Still, the ISDB contains substantial nonpriority constituent data for the four organic chemicals industrial categories.

Based on ISDB, raw loadings to POTWs of nonpriority hazardous constituents are estimated to be approximately 64,000 metric tons per year, of which only 736 metric tons constitute nonpriority metals. This analysis indicates that the major organics industries discharge approximately 2.5 kilograms of nonpriority constituents for each kilogram of priority constituents. Information collected from a variety of data sources suggests that nonpriority constituents also are discharged in significant quantities by numerous other industries. Even if extensive loadings information existed, there is a lack of technical data necessary to determine fate and effects of these compounds. Before EPA can effectively regulate any of these compounds, it will be necessary to improve our knowledge of the sources, quantities, and impacts of these constituents.

- Discharge of Solvents and Other Common Organics to POTWs

Certain priority organics, especially chlorinated solvents, aromatic hydrocarbons, and phthalate esters, frequently are detected in POTW influent wastewaters. Nonpriority organic solvents, such as xylene, methyl ethyl ketone, acetone, ethyl acetate, methanol, and others also are projected to be common constituents of POTW wastewaters. The prevalence of these organic compounds in POTW wastewater raises concerns about potential effects on human health, the environment, and POTW operations when discharged to sewers.

Solvents may be discharged by a broad range of industrial categories. Consequently, any regulatory strategy to develop and implement solvent controls must adequately reflect the number and variety of possible sources of solvent wastes.

- Pollutant Fate Within POTW Treatment Systems

  Assuming a fully acclimated biological treatment system, EPA estimates that 92 percent of all pollutants are removed by POTWs from discharges to surface waters. Under this scenario, 14 percent of all pollutants are air-stripped, 16 percent are removed to sludge, 62 percent are biodegraded, while 8 percent pass through to receiving waters. Assuming unacclimated POTW treatment, an estimated 82 percent of all pollutants are removed by POTWs from discharges to surface waters. Under this second scenario, 25 percent of all pollutants are air-stripped, 14 percent are removed to sludge, 43 percent are biodegraded, while 18 percent pass through to receiving waters. As indicated by these projections, the degree of biological acclimation in POTW treatment units may significantly affect overall POTW removal efficiencies, as well as pollutant fate within treatment systems. Generally, as system acclimation decreases, POTW removal efficiencies tend to decrease, while pollutant quantities air-stripped tend to increase due to reductions in competing processes, such as biodegradation. Without additional information on wastewater discharge patterns and biological acclimation rates, EPA cannot at this time determine which treatment scenario is more representative of actual treatment conditions at POTWs accepting industrial wastewater.

- Evaluation of the Fate and Effects of Hazardous Waste Discharges

  The analysis of the fate and effects of DSS pollutant discharges to POTWs shows clearly that environmental degradation can occur as a result of these discharges. However, quantitative estimates of these effects are hampered by a lack of environmental criteria and a lack of available data. There are four significant pollutant fates within POTW treatment systems, including air-stripping, adsorption to sludge, biodegradation, and pass through to receiving waters. An estimated total annual loading of 92 million kilograms of hazardous pollutants enter POTWs nationwide. While these loadings are important, findings on sludge and water quality impacts show that the significant effects are associated with the toxicity and characteristics of specific pollutants and not just the quantities of pollutants entering the environment.

- Adequacy of Existing Government Controls on the Discharge of Hazardous Wastes to Sewers

  Substantial amounts of hazardous waste constituents have been regulated, and sufficient authorities do exist under CWA and RCRA to control the known impacts associated with the discharge of hazardous wastes to sewers. This finding supports retention of the DSE at the present time, recognizing the logic of RCRA's reliance on CWA's pretreatment program for regulation of the discharge of aqueous hazardous wastes to sewers. At the same time, deficiencies exist in Federal pretreatment standards and weaknesses in local pretreatment programs that could be improved, under existing authorities, to better protect human health and the environment.

A basic lack of information on releases of hazardous wastes to ground water and air from POTWs requires that further study be undertaken prior to completion of the assessment of the need for additional regulatory controls. These potential impacts may require increased reliance on RCRA and/or other statutes to fill gaps in protection afforded by the provisions of the CWA.

- Recommendations

The following four recommendations for improving controls on hazardous waste discharges to sewers have been derived from the findings of the Domestic Sewage Study:

- Additional research, data collection, and analysis are necessary to fill information gaps on sources and quantities of hazardous wastes, their fate and effects in POTW systems and the environment, and the design of any additional regulatory controls which might be necessary.

- Improvements can be made to Federal categorical standards and local pretreatment controls to enhance control of hazardous wastes discharged to sewers.

- EPA should emphasize improvement of controls on hazardous wastes through ongoing implementation of water programs. This will require coordination with the water quality program, sludge management program, and enforcement programs.

- RCRA, CERCLA, and CAA should be considered along with CWA to control hazardous waste discharges and/or receiving POTWs if the recommended additional studies indicate problems.

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

This report presents the results of the Domestic Sewage Study, a study conducted by the U.S. Environmental Protection Agency (EPA) in response to a specific Congressional mandate in the Hazardous and Solid Waste Amendments (HSWA) of 1984. These amendments to the Resource Conservation and Recovery Act (RCRA) added Section 3018(a), which required that:

> The Administrator shall, not later than 15 months after the date of enactment of the Hazardous and Solid Waste Amendments of 1984, submit a report to the Congress concerning those substances identified or listed under section 3001 which are not regulated under this subtitle by reason of the exclusion for mixtures of domestic sewage and other wastes that pass through a sewer system to a publicly owned treatment works. Such report shall include the types, size and number of generators which dispose of such substances in this manner, the types and quantities disposed of in this manner, and the identification of significant generators, wastes, and waste constituents not regulated under existing Federal law or regulated in a manner sufficient to protect human health and the environment.

In response to this mandate, a study plan was prepared, circulated for Agency-wide comment, and approved early in 1985. Project responsibility resided with the Office of Solid Waste and Emergency Response (OSWER). OSWER delegated lead responsibility to the Office of Water (OW) because of OW's experience in performing similar analytical studies, such as the Regulatory Impact Analysis of the General Pretreatment Regulations. An internal Agency work group was established to provide advice and to review the report. In addition, Science Applications International Corporation (SAIC) provided significant technical support. Technical work began in March 1985 and was completed in October of that year.

1.1 PURPOSE

The purpose of the Domestic Sewage Study is to evaluate the impacts of wastes discharged to local wastewater treatment plants as a result of the Domestic Sewage Exclusion [specified in Section 1004(27) of RCRA and codified in 40 CFR 261.4(a)(1)]. Under Section 1004(27) of RCRA, solid or dissolved material in domestic sewage is not, by definition, a "solid waste" and, as a corollary, cannot be considered a "hazardous waste." Therefore, this material is exempt from RCRA regulation. In codifying this statutory provision, Section 261.4(a)(1) of 40 CFR provides that "any mixture of domestic sewage and other wastes that passes through a sewer system to a publicly owned treatment works for treatment" is similarly not a solid waste.

Thus, the Domestic Sewage Exclusion (DSE) means that a hazardous waste, when mixed with domestic sewage (hereinafter referred to as DSE waste), is no longer considered a solid waste and consequently, no longer considered hazardous by definition. The premise behind the DSE is that it is unnecessary (and redundant) to subject hazardous wastes mixed with domestic sewage to RCRA management requirements since these DSE wastes would receive the benefits of treatment offered by publicly owned treatment works (POTWs) and be regulated under Clean Water Act programs, such as the National Pretreatment Program.

1.1.1 Statutory Mandate

The statutory language in Section 3018(a) identified three basic areas of interest to be addressed in the Domestic Sewage Study:

- Types, size, and number of generators that dispose of wastes pursuant to the DSE
- Types and quantities of wastes disposed of under the DSE
- Significant generators, wastes, and constituents not sufficiently regulated to protect human health and the environment.

Interest in these three issues stems from Congressional concern that the DSE may be a significant loophole in RCRA. EPA stated in the Preamble to the 1980 RCRA regulations that, while the National Pretreatment Program should ensure that environmental problems did not occur as a result of the DSE, the Agency's action to continue the exclusion was not based on any formal determinations about the health and environmental risks of such wastes in sewers. Instead, EPA acknowledged that maintenance of the DSE was based solely on Congressional intent. Congress, by requiring EPA to conduct the Domestic Sewage Study, clearly has directed the Agency to revisit this issue.

1.1.2 Legislative History

Analysis of the legislative history of the HSWA indicates that Congress was interested particularly in having EPA evaluate the efficacy of the interaction between the Nation's hazardous waste management and pretreatment programs. Congressman Molinari (R.N.Y.), the sponsor of the amendment adding Section 3018, characterized the Domestic Sewage Study as an effort:

> ... Quantifying, as accurately as possible, the nature and scope of hazardous waste disposal into domestic sewers, including the types of wastes and wastestreams; the extent to which the exclusion is justified and should be modified or eliminated; and the adequacy of pretreatment as a means of dealing with this problem (emphasis added).(1)

Congressman Molinari further clarified the intent behind the study by saying that:

> The purpose of the study is to identify gaps currently in RCRA which may threaten public health and the environment. My amendment would simply require EPA to review the discharge of hazardous wastes listed under RCRA and estimate the scope of hazardous waste currently exempt from regulation....If the receiving publicly owned treatment plants can handle the waste in a manner which adequately protects human health and the environment, then regulatory change will not be necessary (emphasis added).(1)

1.2 REGULATORY AND ENVIRONMENTAL BACKGROUND FOR THE DOMESTIC SEWAGE STUDY (DSS)

Because the DSE occurs at the intersection of two major environmental programs -- RCRA and the Clean Water Act (CWA), its regulatory and environmental impacts are both extensive and complex. To understand these impacts, it is important first to understand key RCRA and CWA features relevant to the DSS. Table 1-1 summarizes and compares the RCRA and pretreatment programs. The following sections present an overview of each program in terms of regulatory approaches, affected regulatory communities, and environmental concerns, and highlight the differences between the programs. More detailed information on these programs is found in Chapter 6 of this report.

TABLE 1-1. COMPARISON OF MAJOR COMPONENTS OF THE RCRA AND PRETREATMENT PROGRAMS

PROGRAM AREA	PRETREATMENT	RCRA
PARTIES REGULATED	• 14,000 categorical industries (covering 22 industrial categories) • Unknown number of noncategorical industrial users • 1,463 POTWs (comprising 80 percent of National POTW flow) required to develop Federal programs • All other POTWs	• 56,000 HW generators (generators <1000 kg/mo exempted) • 12,500 HW transporters • 4,800 HW treatment, storage, and disposal facilities (TSDFs)
POLLUTANTS/ MATERIALS REGULATED	• 126 priority pollutants (metals and toxic organics) • Nonconventional pollutants • Pollutants regulated by prohibited discharge standards that may cause: - Fire or explosion - Corrosion (pH <5) - Obstruction - Interference - Heat - Pass through • Any other pollutant covered by local limits	• Characteristic wastes that exhibit one or more of the following: - Ignitability - Corrosivity - Reactivity - EP Toxicity • Listed Wastes - covering characteristic wastes, acute hazardous wastes, and toxic wastes (pollutants covered include App. VIII 375 hazardous constituents)
CONTROL AUTHORITIES	• EPA HQ • EPA Regions • 21 States have approved programs • 1,278 POTWs have approved programs	• EPA HQ • EPA Regions • 13 States have interim authorization • 33 States have pre-HWSA final authorization
TYPE OF STANDARDS EMPLOYED	• Categorical standards: - Numerical limits for selected 126 pollutants and nonconventionals - Technology-based - Production- or concentration-based • Local limits: - Numerical and absolute prohibitions • General and specific prohibitions	• Standards for generators and transporters are concerned principally with handling waste analysis and manifesting • TSDFs are subject to a variety of operational and design standards

TABLE 1-1. COMPARISON OF MAJOR COMPONENTS OF THE RCRA AND PRETREATMENT PROGRAMS (Continued)

PROGRAM AREA	PRETREATMENT	RCRA
PERMITTING MECHANISMS	• IUs discharging to about 1,500 pretreatment POTWs controlled by "permit, contract, order or similar means" • Other IUs may be permitted by States, although no explicit regulations currently exist • POTWs regulated by Federal or State NPDES permits	• TSDFs regulated by a two-phase permitting system - Part A and Part B permits • Permits-by-rule for certain disposal practices, including HW treatment at POTWs
RECORDKEEPING/ REPORTING REQUIREMENTS	• POTWs: - Industrial Waste Survey - to identify IUs, pollutants, name, address - Discharge Monitoring Reports - a NPDES reporting requirement - POTW Annual Report - annual summary of pretreatment activities • IUs: - IWS response - Permit application - Baseline Monitoring Report (within 180 days of cat. std. effective date) - Compliance Date Report (within 90 days of compliance date for cat. std.) - Self-monitoring reports - Slug load notifications	• Generators: - Notify EPA - to obtain I.D. No. - Maintain waste analysis records - Maintain manifests for 3 years - Submit Biennial Report - covering generating activities - Submit Exceptions Report - when manifest not received • Transporters: - Notify EPA for I.D. number - Comply with manifesting regulations • TSDFs: - Notify EPA for I.D. number - Comply with manifesting regulations - Maintain waste analysis records - Maintain operating records - Submit Biennial Report on wastes received, generators, methods of treatment, storage, etc.
INSPECTIONS AND SAMPLING	• Federal/State Inspections: - Compliance Sampling Inspections - Compliance Evaluation Inspections - Compliance Biomonitoring Inspections - Performance Audit Inspections - Pretreatment program audits - NPDES self-monitoring	• Federal Inspections - primary agent for RCRA enforcement • State Inspections - compliance evaluation program

TABLE 1-1. COMPARISON OF MAJOR COMPONENTS OF THE RCRA AND PRETREATMENT PROGRAMS (Continued)

PROGRAM AREA	PRETREATMENT	RCRA
INSPECTIONS AND SAMPLING (Continued)	• POTW Compliance Monitoring - Routine industrial demand monitoring - Compliance monitoring - IU self-monitoring • Federal/State IU monitoring (backup compliance sampling of IUs)	
ENFORCEMENT	• Federal Authority: - Civil penalties up to \$10,000/day per violation - Criminal fines up to \$25,000/day and/or imprisonment up to 1 year per violation - Civil remedies • State Authority: - Civil penalties up to \$5,000/day per violation - Criminal fines up to \$10,000/day per violation • POTW's Authority: - Typical penalties range from \$100 to \$1,000/day - Also emergency relief	• Federal Authority: - Civil penalties up to \$25,000/day - Criminal fines up to \$25,000 (\$50,000)/day depending on type and up to 1-2 years imprisonment - Knowing endangerment - criminal fines up to \$250,000 and imprisonment for 2-5 years • State Authority: - Interim Authorization - civil or criminal up to \$1,000/day - Final Authorization - civil up to \$10,000/day per violation and criminal up to \$10,000/day per violation and at least 6 months imprisonment.

1.2.1 The RCRA Program

Hazardous waste management under RCRA often has been characterized as "cradle to grave" management. A firm generating solid wastes is required to determine if such waste is hazardous (either a waste listed as hazardous by EPA or which exhibits certain hazardous characteristics). Any generator of a hazardous waste must notify EPA. If the generator chooses to move the waste offsite for treatment or disposal, a paperwork trail (manifesting) must be maintained by the generator, transporter, and the receiving treatment, storage, or disposal facility (TSDF). Any wastes shipped offsite to be treated, stored, or disposed of must be sent to an authorized hazardous waste management facility, such as a secure landfill, treatment unit, or land disposal facility. Wastes managed onsite (e.g., in wastewater treatment units, incinerators, or surface impoundments), like those shipped offsite, must be handled according to specific management and technical requirements in RCRA. As shown in Table 1-1, there are approximately 56,000 generators and 4,800 TSDFs subject to RCRA.

1.2.2 The National Pretreatment Program

In contrast to RCRA, the National Pretreatment Program under the CWA has a different charge -- the control of industrial wastewater discharges to the Nation's sewers. There are approximately 15,000 POTWs that treat domestic, nonresidential, and industrial wastewaters in the United States. While key provisions of the National Pretreatment Program apply to all POTWs, approximately 1,500 of these POTWs are required by the General Pretreatment Regulations (40 CFR 403) to have Federally approved local pretreatment programs. These facilities treat 82 percent of all industrial wastewater discharged to POTWs and over 90 percent of wastewater from industries subject to National categorical pretreatment standards (described below).

These POTWs must develop pretreatment programs because they meet one of the following criteria:

- Design flow greater than five million gallons per day (mgd)
- Design flow of less than five mgd, but receive nondomestic wastes that have caused treatment plant upsets, contaminated sludge, or violated permit limits.

A local pretreatment program is designed to achieve four basic objectives: (1) to prevent pass through; (2) to prevent plant interference; (3) to prevent sludge contamination; and (4) to protect worker health/safety. To date, 1,278 POTWs have received EPA approval of their pretreatment programs.

The General Pretreatment Regulations establish two types of Federal standards to control toxic wastewater discharges from IUs into treatment plants: (1) prohibited discharge standards, and (2) categorical pretreatment standards. Prohibited discharge standards apply to all industrial and commercial establishments connected to all POTWs Nationwide. They prohibit discharges that are flammable, explosive, or corrosive; obstruct flow; upset treatment processes; or increase temperature. These standards are particularly relevant to control the discharge of DSE wastes.

Categorical pretreatment standards originally were to be issued for 34 specific industrial categories and 129 pollutants. EPA subsequently exempted several industries and pollutants from regulation. Currently, categorical standards apply to 22 specific industrial categories and cover 126 priority pollutants. These EPA-developed, industry-specific performance standards are applicable to regulated firms no matter where they are located in the country. EPA estimates that roughly 14,000 IUs nationally are subject to categorical pretreatment standards.

RCRA and pretreatment overlap because many of these categorical IUs also may be RCRA generators. For example, the largest industrial category subject to pretreatment standards is the metal finishing industry. At the same time, plating sludges from the metal finishing industry are a listed hazardous waste under RCRA.

The pretreatment regulations also require that POTWs develop pollutant-specific local limits to implement general prohibitions against pass through, interference, and sludge contamination, as well as the specific prohibitions identified in the prohibited discharge standards. Local limits apply to affected IUs in the POTW's service area.

1.2.3 Comparison of RCRA and Pretreatment

Three major differences are apparent between the RCRA and pretreatment programs. First, the two programs regulate pollutant discharges to different environmental media. CWA protects the Nation's waters. To provide this protection, the National Pretreatment Program regulates toxic pollutants in wastewater and sludge. RCRA focuses on hazardous wastes in all environmental media -- not only in wastewater and sludge, but also in ground water and air.

In addition to the pretreatment program, other statutes could potentially minimize risks from the disposal of DSE wastes. The Clean Air Act (CAA), Occupational Health and Safety Act (OHSA), the Safe Drinking Water Act (SDWA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may operate to prevent harm to health and the environment. These statutes are discussed in Chapter 6.

A second major difference between the RCRA and pretreatment programs is the types of substances chosen for regulation -- toxic pollutants versus hazardous wastes. Federal pretreatment standards are aimed primarily at the control of 126 toxic pollutants. Although the pretreatment program emphasizes these pollutants, EPA has established standards for other pollutants as well. Further, municipalities can regulate additional pollutants through local limits and prohibited discharge standards. In order to do so, a municipality must engage in an analytical process to identify additional pollutants that may interfere with plant operations, contaminate sludge, or pass through the treatment system. To date, however, POTWs have not concentrated on hazardous wastes.

RCRA, on the other hand, is oriented toward hazardous wastes. Wastes may be deemed hazardous if they possess certain characteristics or if they have been specifically listed by EPA. Listed wastes may contain one or more of 375 hazardous constituents.

The third difference between RCRA and pretreatment is in Federal responsibilities. In the former program, the Federal government retains a much greater role in standards development, inspections, and enforcement. States can receive RCRA program approval, but EPA continues to assert a pervasive oversight role. RCRA places no responsibilities at the local level. The pretreatment program, on the other hand, relies heavily on localities to be principal actors in standard setting, inspections, and enforcement, making use of POTW expertise on local conditions. EPA and approved States also may exercise review and pretreatment oversight functions, but their involvement is not intended to be as uniformly direct as in the RCRA program.

One last factor affects the interaction between RCRA and pretreatment, namely the respective timing of the development and implementation of these programs. RCRA was passed by Congress in 1976 and its key implementing regulations were promulgated from 1980-1982. The major thrust of toxics control under the National Pretreatment Program was established in the CWA Amendments of 1977; the General Pretreatment Regulations became final in January 1981. The development of these programs basically has been simultaneous. Thus, there has been little time to observe, analyze, and respond in formulating pretreatment controls that address problems caused by DSE wastes. This factor gives special relevance to the DSS.

1.2.4 Potential Environmental Impacts Associated with DSE Wastes

Congress expressed specific concern that existing regulatory controls on DSE wastes may not adequately protect human health and the environment. As indicated in Figure 1-1, the POTW receiving environment is quite broad and impacts associated with DSE wastes potentially could affect all media. The DSS identified six major impacts:

- Water Pollution - which can occur as a result of improper POTW operation and maintenance. It also can occur as a result of IU discharges that bypass, pass through, or upset the treatment plant.
- Sludge Contamination - which can occur if IUs fail to remove pollutants of concern from their discharges. As a result, the municipality may be limited in its disposal options.

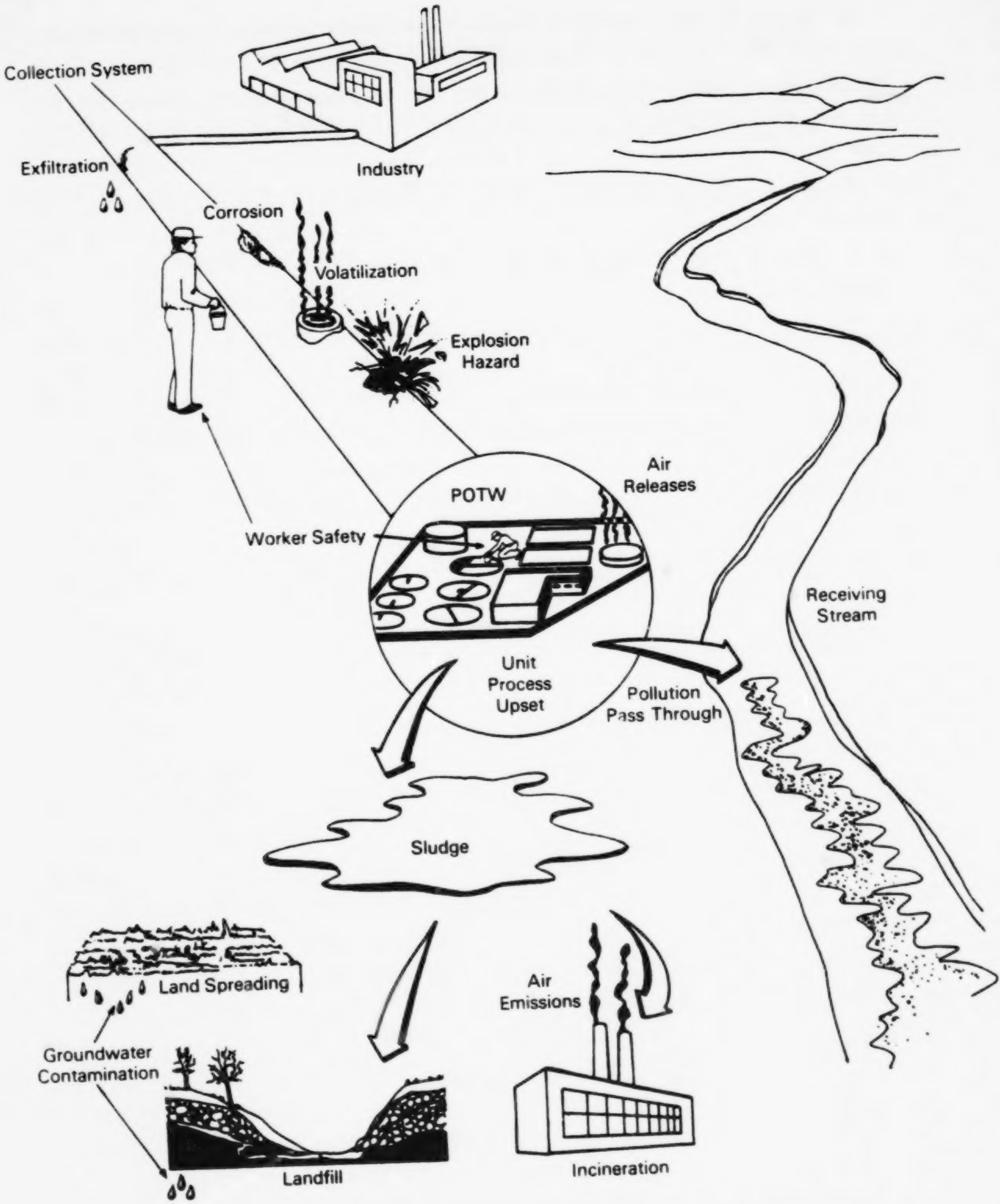
Collection System
Industry
Exfiltration
Corrosion
Volatilization
Explosion Hazard
Air Releases
POTW
Worker Safety
Receiving Stream
Unit Process Upset
Pollution Pass Through
Sludge
Land Spreading
Groundwater Contamination
Air Emissions
Landfill
Incineration

FIGURE 1-1. POTENTIAL PATHWAYS AND ENVIRONMENTAL IMPACTS ASSOCIATED WITH DSE WASTES

- Air Pollution - which can occur from volatilization in the collection system or at the POTW, or through incineration of sludges.

- Worker Health and Safety - which can be jeopardized by industrial discharges that result in explosions and worker exposure to toxics in the wastewater, fumes, or sludge.

- Overall POTW Operation - which may be adversely affected due to upset and interference problems caused by industrial discharges.

- Ground Water Pollution - which may occur due to POTW sewer exfiltration and leachate from POTW sludge.

1.3 METHODOLOGY FOR THE DOMESTIC SEWAGE STUDY

EPA's approach to conducting the DSS followed directly from the language of Section 3018(a). Three goals were established for the Agency's work:

- Determine sources and amounts of hazardous waste being discharged to municipal sewage collection systems.

- Determine effects of hazardous waste discharges on POTWs, human health, and the environment.

- Evaluate current methods for the control of hazardous waste discharged to municipal sewage systems at the Federal, State, and local levels.

1.3.1 Data Sources

In light of the time and resources available for the study, EPA had to rely as much as possible on previously collected information and included limited sampling and analysis data. Moreover, since Congressional interest centered on a National evaluation rather than site-specific characterizations, emphasis was given to the use of comprehensive National environmental data bases. Guided by these considerations, EPA established a two-phased approach to the study. In Phase 1 of the study (from March to June 1985), intensive data collection and analysis occurred in order to judge the adequacy of existing information and to design effective methods of analyzing data. Phase II (from July to October 1985) consisted of interpretation of the information collected.

In Phase I, major existing data bases available in the Office of Solid Waste (OSW) and the Office of Water were reviewed in detail. Table 1-2 lists these 13 principal data sources. To supplement data available from OSW and OW, several State, local, and industrial data sources were explored and used. Selected States, EPA Regions, and municipalities were contacted for information on hazardous waste discharges to POTWs. Permit files also were examined and baseline monitoring reports from categorical IUs were analyzed. In addition, spills and enforcement information was solicited. Finally, data from major pretreatment cities were provided by the Association of Metropolitan Sewerage Agencies (AMSA), which conducted a survey of its membership on hazardous waste issues.

All of these data sources -- both National and site-specific -- were evaluated, both for their relevance to specific study questions and their accessibility. Table 1-3 shows this evaluation of major data sources. The two most complete sources for data were the Industry Studies Data Base (ISDB) and the Industrial Technology Division (ITD) organic chemicals/pesticides data bases.

1.3.2 Availability of Data

In Phase 1 of the study, several data characteristics were identified. First, much of the available data were specific to different media (either water or hazardous waste, but not both). Although RCRA and water data bases contained extensive information on sources, wastestreams, management practices, fate, and effects relevant to their respective regulatory mandates, this information could not be extended further. For example, ITD's data, while containing excellent information on concentrations of constituents in wastewaters, were largely restricted to the 126 priority pollutants and the categorical industries. Information on solid wastes and hazardous waste generation, nonpriority pollutants, and less traditional industries generally was not available from water data sources, either Nationally or locally. Conversely, hazardous waste data rarely contained constituent-specific information (i.e., pollutant concentrations) and were much less rigorous when water-related disposal practices were involved (e.g., discharge to sewers or rivers). Thus, one of the methodological challenges, confronted throughout

TABLE 1-2. PRINCIPAL DATA SOURCES USED IN THE STUDY

- Office of Solid Waste Data
  - ISDB - a large data base characterizing residuals from organic chemicals and related industries
  - Damage Incidents Data Base - a nationwide compilation of hazardous waste mismanagement incidents
  - Hazardous Waste Data Management System - a large data base tracking permit, compliance, and enforcement status of RCRA facilities
  - National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities - a survey containing waste characteristic, quantity, and cost data on generators and TSDFs
  - Small Quantity Generator (SQG) Survey - a data base profiling SQGs, management practices, and quantities
  - Constituent Hazard Classification System - a chemical effects data base associated with ISDB
  - Delisting Petitions Status Matrix System - an automated compilation of delisting petitions with information on wastestreams.
- Office of Water Data
  - Existing ITD Data Bases and Monitoring and Data Support Division (MDSD) Summary Sheets - survey and sampling results for regulated and unregulated pollutants associated with development of water regulations
  - The 40 POTW Study Data - comprehensive POTW toxics sampling results at 40 municipalities
  - Other Municipal Wastewater Sampling Studies, including the 4 City, 25 City, 30 Day, Combined Sewer Overflow and Seattle Metro Pretreatment Toxicant Study
  - Pretreatment Regulatory Impact Analysis (RIA) Data - a data base assembled to evaluate the effectiveness of the National Pretreatment Program.
  - Paragraph 4(c) Studies - containing data identifying municipal nonpriority organic chemicals in industrial wastewaters
  - NEEDS Data Base - the Construction Grants data base containing survey profile information on POTWs.

TABLE 1-3. EVALUATION OF OW/OSW DATA BASES

DATA ELEMENTS	DATA ON INDUSTRIAL DISCHARGERS									DATA ON KEY INDUSTRIAL SEGMENTS						TREATMENT PLANT DATA					EFFICIENCY CONCERNS				
DATA SOURCES	Number of Hazardous Waste Generators	Hazardous Waste Type/ Quantity	Number of Indirect Dischargers	Hazardous Waste Type/ Quantity Discharged to POTW	RCRA/Priority Pollutants Detected	RCRA/Priority Pollutant Concentration/Mass	Other RCRA Pollutants Detected	Other RCRA Pollutant Concentration/Mass	Treatment/Removals	Major Organic Generators	Major Metal Generators	Formulators/Specialty Chemical Users	Waste Management Services	Services/SQG	Miscellaneous	RCRA/Priority Pollutants Detected at POTW	RCRA/Priority Pollutant Concentration/Mass at POTW	Other RCRA Pollutants Detected at POTW	Other RCRA Pollutant Concentration/Mass at POTW	POTW Fate/Effects	Availability	Recency	Computerized	Geographic Accessibility	Confidentiality
RIA	2	2	*	*	*	*	*	*	*	2	2	*	2	*	*	*	*	*	*	*	1	2	1	1	1
Hazardous Waste Data Management System	2	2	*	*	*	*	*	*	*	2	2	2	2	*	2	*	*	*	*	*	1	2	1	1	1
SQG	1	1	1	1	2	2	2	2	2	*	2	2	*	1	2	*	*	*	*	*	1	1	1	1	1
Industry Studies Data Base	1	1	1	1	1	2	1	2	2	1	*	2	*	*	*	*	*	*	*	*	1	1	1	1	2
Biennial Survey	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	2	1	1
ITD Organic Chemicals/ Pesticide Data Base	2	2	1	1	1	1	*	*	1	1	*	2	*	*	*	*	*	*	*	*	1	1	1	1	2
Other ITD Data Bases	2	2	1	1	1	1	*	*	1	*	1	2	*	2	2	*	*	*	*	*	1	2	*	1	1
50 POTW, 30 Day, etc.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	*	*	2	1	2	1	1	1
Paragraph 4C	*	*	*	*	1	*	1	*	*	2	2	2	*	*	2	1	*	1	*	*	1	2	1	1	1
Seattle Metro	*	*	*	*	1	1	1	1	*	*	*	2	2	2	*	1	1	1	1	2	1	1	1	1	1
BWR Data	2	2	*	2	1	1	*	*	*	*	1	*	*	*	*	*	*	*	*	*	1	1	*	2	1
POTW Plant Data (PT, 301(h), Spills)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	*	*	2	1	1	*	2	1
POTW Industrial Data	*	*	2	2	1	1	2	2	2	2	2	2	2	2	2	*	*	*	*	*	1	1	*	*	1
State Pretreatment/ Hazardous Waste Data	2	2	1	1	1	1	2	2	*	2	2	2	2	2	2	*	*	*	*	*	1	1	2	2	1
HDSD Summary Sheets	*	*	1	2	1	1	*	*	1	*	1	2	*	*	2	*	*	*	*	*	1	1	1	1	1

KEY: 1 = Substantial data   2 = Limited data, or major assumption required for use   * = Little or no data the DSS, was the selective merging of discrete data bases across programs to arrive at meaningful National estimates.

A second consideration that affected this study was the lack of sampling and analytical data on many of the wastes and compounds being studied. Data on many of the organic compounds that may be hazardous and present in municipal and industrial influents or effluents simply were not available. This may, in part, be explained by the media-specific orientation of the data bases discussed above. Likewise, the complexity, expense, and reliability of analytical procedures also hinder efforts to detect and quantify the presence of these substances.

A final consideration of the DSS, which particularly influenced the methods and results of the fate and effects work, relates to a fundamental lack of knowledge on the behavior and impacts of many hazardous constituents. For example, little empirical data exist on the volatilization of toxic organic compounds in POTW collection systems and treatment works. Similarly, critical information on the basic kinetics of these compounds in treatment and receiving environments has not yet been developed. In addition, a study of the phenomenon of sewer exfiltration and its impacts on ground water has yet to be undertaken. Thus, information central to a complete resolution of the adequacy of controls on DSE wastes was lacking.

1.3.3 Central Study Approaches

These three considerations influenced EPA's approach to the study. In view of these considerations, it was decided that the most appropriate approach would be a traditional pollutant impact study. However, the DSS would cover more pollutants, more industrial sources of hazardous discharges, and more environmental effects than typically considered by the Agency. One hundred and sixty-five pollutants were selected for the study from the universe of about 400 hazardous/toxic pollutants. Chapter 2 explains the methods followed to choose these pollutants. More industrial sources were included, such as waste oil recyclers, hazardous waste landfills, Superfund sites, and small quantity generators. In fact, the study examined 47 industrial categories, 13 more than the 34 categorical industries historically considered in EPA's water regulatory evaluations. In addition, in order to better integrate OSW and OW data bases, a different industrial categorization was developed. Both the industries and the subcategorization scheme used in the study are discussed in Chapter 3. Finally, efforts were made to examine the impacts of DSE wastes on ground water and air (see Chapters 4 and 5).

When data were lacking in any of these areas, it was handled in one of two ways. One way was simply to document the current state of knowledge and additional lines of inquiry necessary. Such findings, in and of themselves, should be useful to the Agency and Congress in assigning priorities for future research.

The second way to handle lack of data was to employ, wherever possible, theoretical work or best professional judgments to overcome data gaps. Thus, pilot studies and basic research and engineering evaluations by the Water Environmental Research Laboratory in Cincinnati (Office of Research and Development) were used to produce estimates of the allocation of DSE wastes to the various receiving environments -- air, water, sludge, etc. In addition, since few criteria (e.g., water quality criteria or air toxics standards) are in place to judge the impacts of releases of hazardous wastes, secondary measures were used to allow for an intuitive assessment of the pathways and the potential for deleterious effects. Examples of these measures include the magnitude of mass released to the environment, ranges in concentrations of releases, proximity to sensitive receptors (e.g., proximity to drinking water intakes) and the number of facilities that may cause a particular problem.

Although the three considerations discussed above shaped the study's approach, the basic objectives -- to determine the types, quantities, and sources of hazardous wastes discharged to sewers and the adequacy of existing controls -- never varied. Chapters 2 through 6 provide more detailed information on the specific methods and data sources used to select pollutants for study, and to perform the industrial, fate, effects, and regulatory analyses. A bibliography of the principal data sources used in the DSS appears at the end of this report.

1.4 REPORT ORGANIZATION

The remainder of this Domestic Sewage Study report consists of six chapters that parallel the statutory interests expressed by Congress in Section 3018(a) of RCRA. The purpose and summary of each chapter is outlined below.

- Chapter 2 - DESCRIPTION OF HAZARDOUS WASTES AND POLLUTANTS STUDIED: discusses the pollutant-specific approach and the reasons for selecting 165 pollutants to study.
- Chapter 3 - TYPES, QUANTITIES, AND SOURCES OF HAZARDOUS WASTES DISCHARGED TO POTWS: presents the methods, data sources, and findings of the characterization of the types, quantities, and sources of hazardous wastes discharged to sewers; includes an analysis of categorical industries, major organics dischargers, other potential sources, and a production/use profile of hazardous wastes.
- Chapter 4 - FATE OF HAZARDOUS WASTES AND POLLUTANTS IN POTW COLLECTION SYSTEM AND TREATMENT WORKS: summarizes methods, data sources, and findings on the fate of hazardous wastes and pollutants in POTW collection and treatment systems; emphasizes state of knowledge on pollutant fate and concentrates on volatilization and exfiltration in collection system and pass through, biodegradation, volatilization, and sludge adsorption in treatment works; also considers potential for POTW interference and ground water contamination as a result of hazardous wastes in treatment works.
- Chapter 5 - EFFECTS OF HAZARDOUS WASTES DISCHARGED TO POTWS: assesses the environmental effects of hazardous waste discharges to POTWs; characterizes loadings to POTWs and the POTW receiving environment generally; assesses the availability of criteria to gauge impacts; contains discrete impacts analyses for surface and drinking waters, air and worker health/safety, and land and ground water.
- Chapter 6 - EVALUATION OF GOVERNMENT CONTROLS ON HAZARDOUS WASTES DISCHARGED TO SEWERS: explains in detail the existing RCRA framework under which DSE discharges occur as well as CWA and other statutory measures to regulate these wastes; also evaluates the effectiveness of pretreatment Nationally and locally in controlling these discharges.
- Chapter 7 - FINDINGS AND RECOMMENDATIONS: summarizes findings and recommendations of the technical study.

CHAPTER 2

DESCRIPTION OF HAZARDOUS WASTES AND POLLUTANTS EVALUATED IN THE STUDY

2. DESCRIPTION OF HAZARDOUS WASTES AND POLLUTANTS EVALUATED IN THE STUDY

As discussed in Chapter 1, Section 3018 of RCRA required EPA to submit a report identifying types, quantities, sources, and effects of hazardous wastes discharged to POTWs under the Domestic Sewage Exclusion. Specifically, this provision called on the Agency to examine "substances identified or listed under [RCRA] Section 3001..." which are not regulated under RCRA due to the domestic sewage exclusion (emphasis added). Section 3018(a) also required EPA to identify "wastes and waste constituents not regulated under existing Federal law or regulated in a manner sufficient to protect human health or the environment" (emphasis added). This statutory language reflects Congressional intent that the Domestic Sewage Study focus primarily on materials designated as hazardous wastes and hazardous waste constituents under the RCRA program.

This chapter explains the study approach adopted to respond to the statutory mandate. More specifically, it explains the methodology employed to select representative hazardous wastes/constituents for evaluation in the study, and discusses the study pollutants and their key characteristics.

2.1 METHODOLOGY FOR THE SELECTION OF DSS POLLUTANTS

At first glance, the effort to identify pollutants relevant to the study may appear straightforward. However, three factors complicated this exercise: (1) the complexity of the regulatory process by which a solid waste is identified as hazardous; (2) the sheer number of potentially hazardous constituents referred to in RCRA regulations; and (3) data base limitations. This section outlines the regulatory intricacies of RCRA's waste identification process, which influenced the waste selection effort. It also discusses the need to adopt a pollutant-specific approach and the specific criteria employed to select compounds. Section 2.2 describes pollutants included in this study.

2.1.1 Regulatory Definition of Hazardous Wastes

Section 1004(5) of RCRA defines hazardous waste as "a solid waste, or combination of solid wastes, which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may:

> (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating irreversible, illness; or
>
> (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

EPA has established two methods by which a solid waste may be determined to be a hazardous waste. First, if it exhibits one or more of four characteristics, it is considered a characteristic waste under RCRA. Currently, the four characteristics that qualify a material as a hazardous waste are:

- Ignitability (40 CFR 261.21)
- Corrosivity (40 CFR 261.22)
- Reactivity (40 CFR 261.23)
- Extraction Procedure (EP) Toxicity (40 CFR 261.24).

In each instance, the characteristic must be demonstrable as measured by a standardized testing method or as determined by a generator's specific knowledge of that solid waste. The Hazardous and Solid Waste Amendments of 1984 require EPA to reevaluate the EP-toxicity test and to develop other hazardous waste characteristics.

Second, if the solid waste (or any part of it) is listed in 40 CFR 261.31-261.33, it is commonly called a listed waste in RCRA regulations. The Agency lists classes or types of solid waste as hazardous waste where it has reason to believe that individual wastes, within the class or type of waste, are typically or frequently hazardous. The RCRA regulations establish four lists:

- F-list -- hazardous waste from nonspecific sources, such as spent cyanide plating baths from electroplating operations
- K-list -- hazardous waste from specific sources, such as leaded tank bottoms from the petroleum refining industry

- P-list -- acutely hazardous commercial chemical products (including off-specification species)
- U-list -- toxic chemical commercial products (including off-specification species).

To date, the Agency has listed 27 hazardous wastes from nonspecific sources on the F-list in 40 CFR 261.31 and 82 hazardous wastes from specific sources on the K-list in 40 CFR 261.32. The P- and U-lists include numerous commercial chemical products or manufacturing intermediates that are considered hazardous wastes if discarded in pure or dilute form.

The hazardous constituents in Appendix VIII to 40 CFR 261 form one basis for determining whether a specific pollutant is a listed waste. A chemical is included in Appendix VIII if it is shown, in reputable scientific studies, to have toxic, carcinogenic, mutagenic, or teratogenic effects on humans or other life forms. Currently, there are 383 chemicals in Appendix VIII. Although Appendix VIII is one criterion for designating a pollutant as hazardous, some wastes appear on a list solely because they exhibit one or more of the characteristics of a hazardous waste.

Two other RCRA provisions affect what material is considered hazardous waste:

- The mixture rule, which states that any solid waste that is a mixture of a hazardous waste and a solid waste also may be a hazardous waste. In the case of a listed hazardous waste [see 40 CFR 261.3(a)(2)(iv)], a waste mixture must be handled as a hazardous waste unless the mixture is specifically delisted by the Agency. In the case of a characteristic hazardous waste [see 40 CFR 261.3(a)(2)(iii)], a waste mixture need not be handled as a hazardous waste if it does not exhibit any of the characteristics of hazardous waste.
- The treatment rule, which specifies that any hazardous waste that is treated may remain a hazardous waste [see 40 CFR 261.3(c)(1)]. In the case of a listed hazardous waste [see 40 CFR 261.3(d)(2)], a treated hazardous waste remains a hazardous waste unless it is specifically delisted by the Agency. In the case of a characteristic hazardous waste [see 40 CFR 261.3(d)(1)], the treated hazardous waste remains a hazardous waste only if the waste continues, after treatment, to exhibit any of the characteristics of hazardous waste. Residuals from the treatment, storage, or disposal of listed or characteristic hazardous wastes are regulated in an analogous manner under RCRA

> regulations [see 40 CFR 261.3(c)(2) and 261.3(d)]. Treated hazardous wastes discharged by point sources regulated under Section 402 of the Clean Water Act are not considered hazardous [see 40 CFR 261.4(a)(2)].

Although both characteristic and listed hazardous wastes are included in this study, it is necessary to recognize that the mixture and treatment rules could operate to alter technically the classification of some wastes as hazardous.

2.1.2 Rationale for Pollutant-Specific Study Approach

Recognizing these regulatory considerations, EPA faced a very basic decision; namely, deciding upon an approach to the study. Two approaches were possible: the study could examine wastestreams and types (the subjects of RCRA regulation) or the study could emphasize specific pollutants (the Clean Water Act's focus). Based on an extensive evaluation of existing water and hazardous waste data sources, the pollutant-specific approach was chosen. Thus, the study's approach was to evaluate mass loadings to POTWs of specific pollutants and waste constituents (such as benzene, tetrachloroethylene, or cyanide). The decision to use this approach derived from four specific considerations:

- Lack of data on types and quantities of generic RCRA wastes discharged to POTWs
- Availability of priority pollutant data for categorical industries in the Office of Water
- Uncertainty in the estimates of waste quantities due to the mixture/treatment rules under RCRA
- Need for evaluation of the fate and effect of pollutants in POTW collection and treatment systems.

Each consideration is discussed below.

2.1.2.1 Lack of Data on the Discharge of RCRA Wastes

Due to the widespread belief that the DSE provides a blanket exemption from notification requirements, most generators have not notified EPA and States of hazardous waste discharges to POTWs. Moreover, even where notification has occurred, data generally have not been collected and organized, in

Federal, State and local data bases, in a manner that allows effective evaluation. Consequently, traditional notification data provide neither comprehensive nor representative information on types and quantities of hazardous waste discharged to POTWs. Recognizing the considerable effect of the DSE on industry notification practices, Congress enacted Section 3018(d) of the 1984 RCRA Amendments, which extends RCRA notification requirements to generators discharging hazardous wastes to POTWs. This provision, however, has not yet yielded significant data for use in the DSS.

Difficulties in relating RCRA data to this study are somewhat heightened by the lack of data on concentrations of specific waste constituents in RCRA wastes. While the extent of waste sampling has increased, many available RCRA background and listing documents contain minimal data on constituent concentrations of listed wastes. Without these data, generic waste loadings (e.g., degreasing solvents, electroplating bath solutions) could not be readily converted to loadings of specific pollutants (e.g., tetrachloroethylene, cyanide). Data on pollutant loadings are essential for the proper evaluation of pollutant fate and effect within POTW systems and the receiving environment.

Notwithstanding the limitations of the RCRA data sources as they relate to the DSE, some RCRA data bases did provide useful information on the discharge of RCRA characteristic and listed wastes to sewers. Where this type of data exists (such as in the Industry Studies Data Base and the Small Quantity Generator Data Base), pertinent data are presented in this report.

2.1.2.2 Availability of Priority Pollutant Data

As part of the 1976 Consent Decree between EPA and the Natural Resources Defense Council, EPA agreed to promulgate technology-based standards for 65 toxic compounds or classes of toxic compounds for 34 categories of industry. One hundred and twenty-nine priority pollutants subsequently were selected by EPA from the original 65 compounds. The number of priority pollutants was later reduced to 126 when three of the original 129 pollutants were removed from consideration. Section 2.1.3.4 provides further background on these priority pollutants.

Because of this Consent Decree, the Office of Water began a thorough examination of the priority pollutants and the industries that discharge them. The Office of Water's Industrial Technology Division (formerly the Effluent Guidelines Division) undertook extensive surveys and sampling to compile information on these pollutants and industries. The availability of such detailed and comprehensive priority pollutant data was another reason that the pollutant-specific approach was adopted.

2.1.2.3 Uncertainty Relating to RCRA Mixture/Treatment Rules

Efforts to quantify POTW loadings of RCRA wastes, both listed and characteristic, are greatly complicated by the uncertain application of RCRA mixture/treatment rules to industrial user practices. As mentioned earlier, under the mixture rule, a listed waste that is diluted remains a listed waste. Accordingly, where a wastewater contains a listed waste, the entire wastewater becomes a listed hazardous waste. Because process wastewaters are often mixed with high-volume nonprocess wastewaters (e.g., cooling water, sanitary wastewaters, etc.) prior to discharge to a POTW, strict application of the mixture rule in these situations results in the generation of massive quantities of dilute hazardous waste. Thus, any failure to consider and relate the possible effects of dilution on hazardous waste generation rules can easily result in confusing and misleading estimates for hazardous waste loadings of listed wastes.

In the case of a characteristic hazardous waste, a diluted or treated waste does not have to be handled as a hazardous waste unless it continues to exhibit any of the hazardous characteristics. Consequently, for the purposes of evaluating the DSE, wastewater characteristics are more appropriately evaluated at the point of discharge to a municipal collection system, after dilution and/or treatment have occurred. In the absence of sampling data on wastewater characteristics at this point of discharge, it is difficult to determine whether the wastestream discharged to the POTW should be considered a hazardous waste under the Domestic Sewage Exclusion.

For one set of industries, the Organic Chemicals industry, EPA used waste estimates (available from the ISDB) of concentrated hazardous wastes generated by industry in production processes and prior to treatment and mixture with wastewaters. This eliminated uncertainties about the effects of treatment and dilution on the accuracy of waste estimates. Where this approach is used in the DSS, resulting estimates are impossible to compare with previous EPA OSW hazardous waste estimates (e.g., Westat/RIA or SQG data bases).

2.1.2.4 Need to Evaluate Pollutant Fate and Effect

Data on loadings of specific pollutants and waste constituents are essential for the proper evaluation of pollutant fate within POTW collection and treatment systems and pollutant effects on POTW operations, human health, and the environment. These analyses are strongly dependent upon examination of physical, chemical, and toxicological properties of specific waste constituents. Observations concerning fate and effects of specific waste constituents then can be applied to generic RCRA wastes containing these constituents. A final benefit of this approach is that it enabled pollutant-specific results to be converted into waste type aggregations (e.g., consolidating all of the volatile organic results to make an estimate of characteristic hazardous waste due to ignitability).

2.1.3 Methodology for Pollutant Selection

Having made the decision to follow the specific pollutant approach, it was then necessary to identify the specific constituents that would be included in the study. Five classes of pollutants regulated under RCRA and CWA were reviewed to identify the appropriate universe of pollutants for the study:

- RCRA Appendix VIII Hazardous Constituents
- RCRA Appendix VII Hazardous Constituents
- RCRA Characteristic Hazardous Wastes
- CWA Priority Pollutants
- Pesticides.

The following subsections briefly describe the five classes.

2.1.3.1 RCRA Appendix VIII Hazardous Constituents

The initial Appendix VIII hazardous constituent list was promulgated as part of the May 19, 1980 RCRA regulations implementing the RCRA program. EPA reviewed the following sets of chemicals for possible inclusion in the Appendix VIII list:

- Pesticides cancelled for some or all uses, or undergoing Rebuttable Presumption Against Registration (RPAR) procedures under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- Chemicals listed as poisonous by Department of Transportation (DOT) regulations
- Pollutants included in the CWA priority pollutant list
- Chemicals found to be actual or potential human carcinogens by the International Agency for Research on Cancer.

These substances were reviewed to determine whether they met the listing criteria specified in the RCRA regulations (see 40 CFR 261.11 and discussion below). The Agency examined diverse toxicological materials (such as RPAR documentation, Cancer Assessment Group materials, and data from the National Institute of Occupational Safety and Health Registry of Toxic Effects) to mak final determinations on specific chemicals.

Appendix VIII has been expanded since the original May 19, 1980 rulemaking, which listed 359 chemicals. There are now 383 chemicals and chemical classes on the Appendix VIII list, including a preponderance of the CWA priority pollutants. Moreover, the Agency has proposed a significant expansion of the Appendix VIII list by adding the so-called "Michigan chemicals list" (see 49 FR 49784). If promulgated as proposed, this regulation would add 120 new chemicals to Appendix VIII.

The Appendix VIII list has considerable regulatory importance for the RCRA program. First, Appendix VIII chemicals may be cited as a basis for listing toxic wastes. Second, when evaluating delisting petitions, the Agency must consider any Appendix VIII constituent (including constituents other than those for which a waste is listed) that may cause a waste to be a hazardous waste. The Agency also may require RCRA permittees to perform ground water and air monitoring for Appendix VIII constituents.

2.1.3.2 RCRA Appendix VII Hazardous Constituents

The Appendix VII list is a subset of Appendix VIII. It identifies constituents that are the basis for placing wastes on the F-list (from nonspecific sources) and the K-list (from specific sources). Currently, there are 114 constituents on the Appendix VII list.

2.1.3.3 RCRA Characteristic Hazardous Wastes

In some instances, the Agency has listed wastes that exhibit hazardous characteristics. For example, certain spent solvents are listed wastes solely because they contain ignitable constituents, such as xylene, acetone, or ethyl acetate. This set of ignitable, corrosive, reactive, and EP-toxic chemicals also was included in the universe of pollutants reviewed for the study.

2.1.3.4 CWA Priority Pollutants

The CWA priority pollutant list originally was developed during negotiations between the Natural Resources Defense Council (NRDC) and EPA. It was incorporated as part of a settlement agreement that ended litigation over the toxics control provisions of the 1972 Federal Water Pollution Control Act (FWPCA) amendments [NRDC v. Train, 8 ERC 2120 (D.D.C. 1976), modified March 1979, October 1982, August 1983, January 1984, July 1984, and January 1985]. Commonly referred to as the "NRDC Consent Decree," this agreement required EPA to promulgate technology-based standards addressing 65 compounds or classes of compounds (Appendix A of this report lists these compounds). This list of toxic pollutants subsequently was adopted by Congress in the 1977 CWA amendments.

The list of 65 compounds and classes of compounds were chosen on the basis of three different sets of criteria:(1)

- Known occurrence of these compounds in point source effluents, in aquatic environments, in fish, and/or drinking water

- Substantial evidence of carcinogenicity, mutagenicity, and/or teratogenicity in human epidemiological studies or in animal bioassay systems

- Likelihood that point source effluents contribute substantially to human hazards, at least locally.

Section 307(a)(1) of the Clean Water Act directed EPA to publish the list of 65 toxic pollutants. The Agency published this list on January 31, 1978 (see 43 FR 4109). Section 307(a) also authorized EPA to revise the list from time to time. The statutory criteria for such revisions are:

- Toxicity of pollutant
- Persistence
- Degradability
- Usual or potential presence of the affected organism
- Importance of affected organisms
- Nature and extent of the effect of the toxic pollutant on such organisms.

Since the list of 65 toxic pollutants includes very broad categories or classes (e.g., chlorinated benzenes, DDT and metabolites, haloethers, etc.) as well as specific compounds, the list actually could encompass hundreds of compounds. To facilitate the evaluation and control of these toxics, EPA believed that it should focus on specific compounds within the classes. Therefore, the Agency developed a list of 129 individual priority pollutants from the list of 65 compounds or classes of compounds. EPA also established a set of criteria that may be used to support a petition to revise the list (see 44 FR 18279). Briefly, these criteria are:

- Toxicity of the pollutant, including acute toxicity (LC-50s); maximum acceptable concentration; embryo-larval and egg-fly tests; dose-related lethal or chronic sub-lethal effects; and information on carcinogenicity, teratogenicity, and mutagenicity

- Persistence of a pollutant, including its mobility and degradability in water

- Bioconcentration, bioaccumulation, and biomagnification of a pollutant or of its degradation properties and effects of the pollutant

- Synergistic propensities and effects of the pollutant
- Water solubility and octanol-water partition coefficient determinations for the pollutant
- Extent of point source discharges into water, including qualitative presence and quantitative concentrations of the pollutant in effluents, ambient water, benthic sediments, fish, and other plant and animal aquatic organisms
- Potential exposure of persons to the pollutant through drinking water, fish, or shellfish consumption; identical exposure of aquatic organisms and wildlife to the pollutant
- Annual production of the pollutant in the United States
- Use patterns
- Capability of analytical methods to identify and quantitatively determine the pollutant's presence in ambient water or wastewaters.

Since January 1978, the priority pollutant list has been reduced to 126 compounds, with the elimination of dichlorodifluoromethane, trichlorofluoromethane, and bis (chloromethyl) ether (see 40 FR 2266 and 46 FR 10723).

Paragraph 4(c) of the Consent Decree [added in March 1979 (NRDC v. Costle, 12 ERC 1833, March 9, 1979 D.D.C.)] also requires EPA to identify and regulate pollutants, other than the priority pollutants, which interfere with, pass through, or are otherwise incompatible with a POTW. At a minimum, EPA was required to evaluate 12 additional compounds and compound classes specified in Appendix C of the Consent Decree. After extensive evaluation of analytical data derived from CWA rulemakings, EPA established a Paragraph 4(c) list containing six nonpriority organic pollutants.(2) These pollutants are carbazole, 1,2,3-trichlorobenzene, 2,4,5-trichlorophenol, 1,4-dioxane, dibenzofuran, and 2,3,6-trichlorophenol.

2.1.3.5 Pesticides

Four general classes of pesticides were reviewed for possible inclusion in the DSS:

I. Phosphorus-containing
II. Nitrogen-containing
III. Halogen-containing
IV. Miscellaneous.

Table 2-1 shows the pesticide classification system used in the study. Pesticides chosen represent all four classes.

The initial DSS pollutant universe drawn from RCRA and CWA encompassed over 475 specific compounds, including RCRA Appendix VIII hazardous constituents and other compounds listed under RCRA regulations (e.g., F-list wastes, P-list wastes, etc.) solely because of their hazardous characteristics (see Appendix B for pollutant descriptions). This initial pollutant universe did not include proposed RCRA hazardous constituents (i.e., Michigan chemicals), although certain proposed constituents (e.g., styrene) were added to the DSS pollutant list based on a subsequent review of industrial and POTW sampling data.

2.1.3.6 Selection of DSS Pollutants

The goal behind the selection of DSS constituents was to ensure the most comprehensive coverage of study pollutants. EPA wanted to choose those RCRA hazardous wastes that would include significant sources of DSE wastes and to characterize accurately the nature of those wastes. To accomplish this, the following five general factors were used to evaluate specific pollutants:

- Regulatory Status: The regulatory status (such as priority pollutant, or listed or characteristic hazardous waste) of each constituent to be studied was important to ensure that a representative cross-section of all CWA and RCRA regulated pollutants/hazardous wastes was included.
- Magnitude of National Production: Congress expressed an interest in significant sources. Therefore, compounds for which National production rates are high (as opposed to specialty chemicals) were used.
- Waste Generation by Specific Industries: Pollutants in the wastestreams of industries known to be large waste generators were of particular interest since these may be more likely to appear in sewers. Other pollutants were selected because of their association with industries known to be industrial users.

TABLE 2-1. PESTICIDE CLASSIFICATION SYSTEM

Pesticide Class	Typical Pesticides in Each Chemical Class
I. Phosphorus-Containing Pesticides	
(i) **Phosphates and Phosphonates**	**Mevinphos, TEPP, Azodrin, Dichlorvos, Bidrin, Naled**
(ii) Phosphorothioates	Diazinon, Methyl Parathion, Parathion, Demeton, Dursban, Fenthion, Zinophos, Dasanit
(iii) Phosphorodithioates	Disulfoton, Phorate, Malathion, Guthion, Ethion, Trithion
(iv) Other Organophosphates	Ruelene, DEF Defoliant, Folox
II. Nitrogen-Containing Pesticides	
(i) Carbamates, Thiocarbamates, and Dithiocarbamates	Carbaryl, Aldicarb, Carbofuran, Bux Ten, Sutan, Eptam, Maneb, Ferbam, Zineb
(ii) Amides, Anilides, Imides, and Hydrazides	Diphenamid, Alachlor, Randox, Propachlor, Captan, Difolatan, MH
(iii) Ureas and Uracils	Diuron, Linuron, Monuron, Bromacial
(iv) Triazines	Atrazine, Propazine, Simazine
(v) Amines, Nitro Compounds, and Quaternary Ammonium Compounds	Picloram, Trifluralin, Benefin, Nitralin, Dinoseb, Diquat, Paraquat
(vi) Other Nitrogen-Containing Compounds	Antu, Dodine, Naptalam
III. Halogen-Containing Pesticides	
(i) DDT and Related Compounds	Methoxychlor, Chlorobenzilate, Dicofol
(ii) Chlorophenoxy Compounds	2,4-D, Silvex, 2,4,5-T, MCPA
(iii) Aldrin-Toxaphene Group	Chlordane, Toxaphene, Endrin, Heptachlor
(iv) Dihaloaromatic Compounds	Amiben, Paradichlorobenzene, Banvel
(v) Highly Halogenated Compounds	Pentachlorophenol, Fenac, Dacthal
IV. Miscellaneous Pesticides	Warfarin, Endothall, Fumarin, Rotenone, Pyrethine, Sodium Fluoroacetate, Omite

- Exertion of Specific Effect: To determine the impact of hazardous wastes on POTWs, pollutants exhibiting specific effects (such as corrosivity, ignitability, or toxicity) were selected.
- Data Availability: Since there was a stated interest in the fate and effect of DSE discharges, constituents that have been measured routinely in industrial/municipal wastestreams yielded particularly good data for review.

Using these 5 factors, EPA selected 165 pollutants for study, all but 15 of which are RCRA constituents. Thirty-eight pesticides were included, 22 of which are either currently regulated under RCRA or proposed to be regulated under RCRA.

The final DSS pollutants were grouped into four categories to facilitate analysis: Tier 1, Tier 2, Tier 2A, and pesticide pollutants. The Tier 1 pollutants consist of EP-toxic metals and F-list solvents. Tier 2 pollutants include other pollutants that are regulated extensively under RCRA hazardous waste regulations and are used and discharged by a wide range of industries. These two sets were selected, in particular, to aid in the evaluation of discharges by "nonorganics" industries.(3) Tier 2A pollutants represent additional constituents detected in discharges from organic chemical industries. Tier 2A and pesticide pollutants were chosen later in the study to enable a more detailed investigation of the organics industries. Figure 2-1 provides an overview of the interrelationship between the various pollutant selection procedures and key study components. The specific reasons behind each pollutant grouping are discussed below.

Tier 1 and 2 Pollutants. Tier 1 and 2 pollutants were selected because:

- RCRA Regulatory Status - The Tier 1 pollutant set consisted of EP-toxic metals and F-list spent solvents. Also, Appendix VII constituents were included since they actually had been cited as a basis for listing F- or K-hazardous wastes.
- Availability of Data - A substantial cross-section of CWA priority pollutants were included because all priority pollutants were also RCRA hazardous constituents and because priority pollutant data are extensively collected by POTW and industrial facilities.

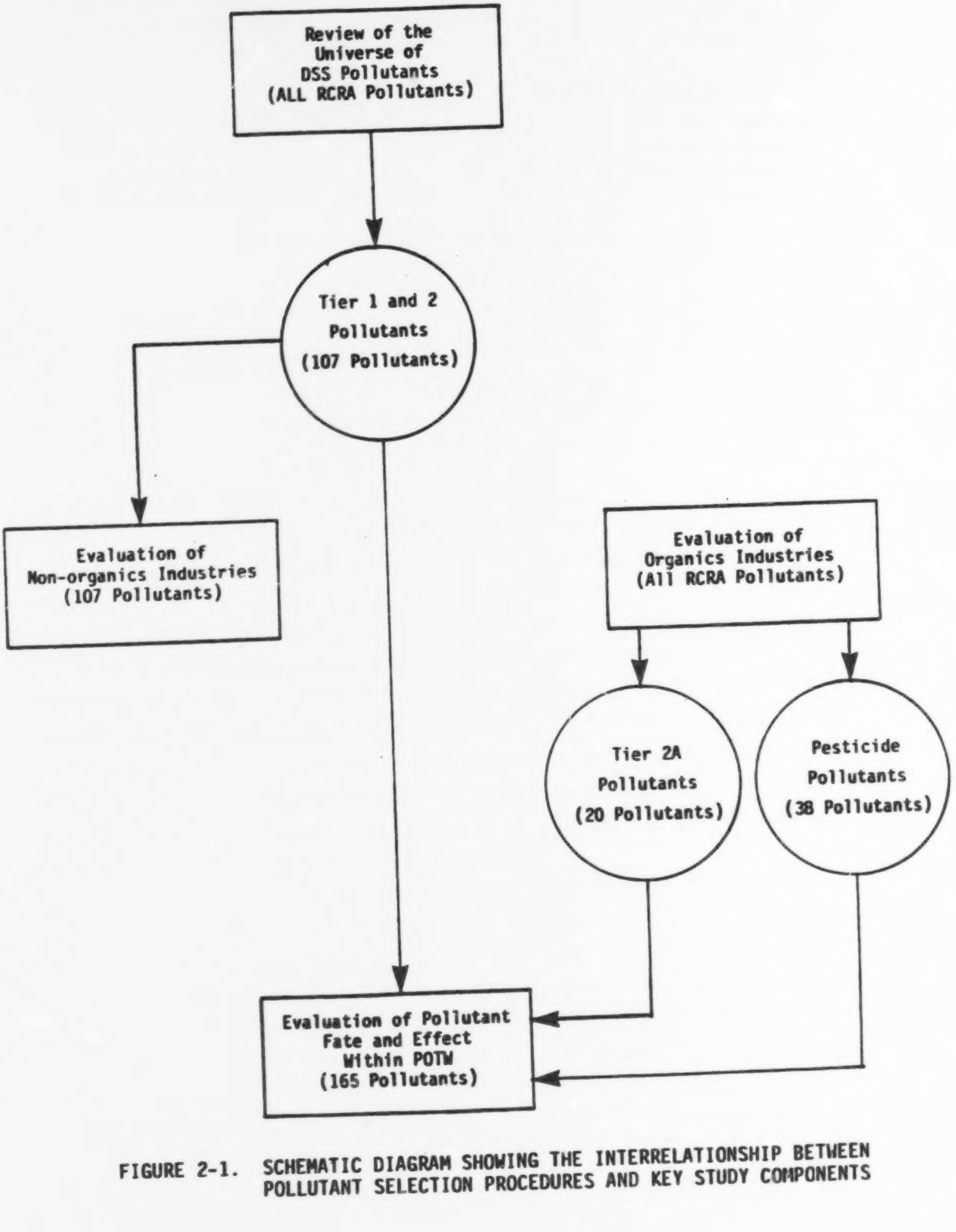
Review of the Universe of DSS Pollutants (ALL RCRA Pollutants)
Tier 1 and 2 Pollutants (107 Pollutants)
Evaluation of Non-organics Industries (107 Pollutants)
Evaluation of Organics Industries (All RCRA Pollutants)
Tier 2A Pollutants (20 Pollutants)
Pesticide Pollutants (38 Pollutants)
Evaluation of Pollutant Fate and Effect Within POTW (165 Pollutants)

FIGURE 2-1. SCHEMATIC DIAGRAM SHOWING THE INTERRELATIONSHIP BETWEEN POLLUTANT SELECTION PROCEDURES AND KEY STUDY COMPONENTS

- Characteristic Wastes - Compounds exhibiting hazardous characteristics, especially ignitability, were given special consideration to enhance coverage of characteristic wastes.

- End Use by Nonorganics Industries - Special preference was given to compounds that may be used widely by nonorganics industries. These compounds include solvents, plasticizers, preservatives, disinfectants, refrigerants, lubricants, etc. This criterion was designed to exclude compounds used predominantly as pesticides or as dye, chemical, or pesticide intermediates in the organics industries.

- Production Rate - Chemicals produced at higher rates were given higher priority.

- 40 POTW Study Detection Frequencies - Pollutants detected with greater frequency in POTW influents, based on sampling/analytical data from the 40 POTW study, were given higher priority.

- Sampling/Analytical Considerations - To facilitate related POTW and industrial sampling efforts for the study, pollutants for which adequate sampling/analytical procedures and standards already exist were included.

Most data used for the pollutant evaluation are provided in pollutant descriptions contained in Appendix B.

Tier 2A pollutants. Tier 2A pollutants consisted of pollutants discharged to POTWs by organic industries. The Tier 2A pollutant list was intended to supplement Tier 1 and 2 sets with the addition of chemicals known to be discharged, in significant quantities, to POTWs by organic industries. Discharge data from the ISDB were reviewed to identify Tier 2A pollutants. Many compounds were not included as Tier 2A pollutants only because they already were listed as Tier 1 or 2 pollutants.

Pesticide Pollutants. Selection criteria for the pesticide pollutants were:

- Representative of Diverse Pesticide Classes - Pesticides were chosen to represent adequately the range of pesticide functional classes. Functionality was selected as the first selection criterion since toxicity has been shown to correlate with chemical structure. For example, broad pesticide classes of insecticides, herbicides, and fungicides tend to exhibit decreasing toxicity, respectively. The representation of the 16 basic classes of pesticides was especially important for pollutant fate and effect analyses.

- Used or Produced in U.S. - The pesticide set also was selected based upon production volume and projections of future use in the United States. For each pesticide functional class, several pesticides were chosen based upon production volume and present discharge levels to POTWs. These pollutants, because of their production volumes, are expected to represent the bulk of potential environmental damage.

- Existing/Proposed RCRA Waste - Where possible, pesticides selected were either existing or proposed RCRA Appendix VIII hazardous constituents. Several of the remaining pollutants were included for functional completeness by using the ITD list of nonconventional pesticides from the final promulgated effluent standards and limitations for the pesticide manufacturing and formulating industry.

Using the appropriate selection criteria for the four lists, 165 pollutants were selected for examination in the Domestic Sewage Study. Section 2.2 describes these pollutants.

2.2 DESCRIPTION OF DSS POLLUTANTS

Table 2-2 lists the 165 DSS pollutants. It also identifies CWA priority pollutants and indicates which pollutants were considered to be volatile or ignitable/reactive. Table 2-3 summarizes the regulatory status of DSS pollutants by indicating regulatory authorities to which the pollutants are subject. Figure 2-2 profiles these DSS pollutants. As can be seen, the overwhelming majority of pollutants (121 constituents or 73 percent) are RCRA Appendix VIII constituents. In decreasing order of size, RCRA Appendix VII hazardous waste constituents account for 74 pollutants (45 percent), CWA priority pollutants 67 pollutants (41 percent), and RCRA characteristic wastes are represented by 41 constituents (25 percent).

Figure 2-3 describes the extent to which key RCRA and CWA pollutant lists are represented in the DSS pollutant list. As demonstrated in the figure, 74, or 65 percent, of all RCRA Appendix VII hazardous constituents are included, while 121, or 32 percent, of all RCRA Appendix VIII hazardous constituents are included in the DSS pollutant list. These results show the representativeness of RCRA pollutants studied. CWA pollutants also are well-represented with 67, or 53 percent, of all priority pollutants selected for study.

TABLE 2-2. LIST OF TIER 1, 2, 2A, AND PESTICIDE POLLUTANTS FOR THE DSS

Tier 1 - EP Toxic Metals and F-List Solvents (34 Pollutants)

Acetone - I/R, V
Arsenic and Compounds - P
Barium and Compounds
N-Butyl Alcohol - I/R
Cadmium and Compounds - P
Carbon Disulfide - I/R, V
Carbon Tetrachloride - P, V
Chlorobenzene - P, I/R
Chromium and Compounds - P
Cresols (3 isomers)
Cyclohexanone - I/R
1,2-Dichlorobenzene - P
Dichlorodifluoromethane - V
Ethyl Acetate - I/R, V
Ethyl Benzene - P, I/R, V
Ethyl Ether - I/R , V
Isobutanol - I/R
Lead and Compounds - P
Mercury and Compounds - P, V
Methanol - I/R, V
Methyl Ethyl Ketone - I/R, V
Methyl Isobutyl Ketone - I/R
Methylene Chloride - P, V
Nitrobenzene - P
Pyridine - I/R, V
Selenium and Compounds - P
Silver and Compounds - P
Tetrachloroethylene - P, V
Toluene - P, I/R, V
1,1,1-Trichloroethane - P, V
Trichloroethylene - P, V
Trichlorofluoromethane - V
1,1,2-Trichloro-1,2,2-Trifluoroethane - V
Xylenes (3 isomers) - I/R, V

Tier 2 - Selected RCRA Pollutants (73 Pollutants)

Acetaldehyde - I/R, V
Acetonecyanohydrin - I/R
Acetonitrile - I/R, V
Acetophenone - V
Acetyl Chloride - I/R, V
Acrolein - P, I/R, V
Aniline - I/R
Antimony and Compounds - P
Benzene - P, I/R, V
p-Benzoquinone
Benzyl Chloride
Bis-(2-Chloroethoxy) Methane - P
Bis-(2-Chloroethyl) Ether - P, I/R, V
Bis-(2-Ethyl Hexyl) Phthalate - P
Bromomethane - P, V
Butyl Benzyl Phthalate - P

P = CWA priority pollutant
I/R = Ignitable or reactive compound
V = Volatile compound

TABLE 2-2. LIST OF TIER 1, 2, 2A, AND PESTICIDE POLLUTANTS FOR THE DSS (Continued)

Tier 2 - Selected RCRA Pollutants (73 Pollutants)

p-Chloro-m-Cresol - P
Chloroethane - P, I/R, V
Chloroform - P, V
Chloromethane - P, I/R, V
2-Chloronapthalene - P
Cumene - I/R, V
Cyanide - P, I/R
Cyclohexane - I/R, V
Di-N-Butyl Phthalate - P
1,3-Dichlorobenzene - P
1,4-Dichlorobenzene - P
1,1-Dichloroethane - P, I/R, V
1,2-Dichloroethane - P, I/R, V
1,1-Dichloroethylene - P, I/R, V
Trans-1,2-Dichloroethylene - P, I/R, V
2,4-Dichlorophenol - P
1,2-Dichloropropane - P, I/R, V
Dichloropropanol
Diethyl Phthalate - P
Dimethylamine - I/R, V
2,4-Dimethyl Phenol - P
Dimethyl Phthalate - P
Di-N-Octyl Phthalate - P
1,4-Dioxane - I/R
Diphenyl Amine
Epichlorohydrin - I/R, V
Ethylene Oxide - I/R, V
Formaldehyde - I/R, V
Formic Acid, V
Furan - I/R, V
Furfural - I/R, V
Hexachloro-1,3-Butadiene - P
Hexachloroethane - P
Hydrazine - I/R, V
Napthalene - P
Nickel and Compounds - P
2-Nitropropane - I/R, V
N-Nitrosodimethyl Amine - P
PCB - P
Pentachloroethane
Pentachlorophenol - P
Phenol - P
Phenylene Diamine
2-Picoline - V
Resorcinol
Tetrachlorobenzene
1,1,1,2-Tetrachloroethane - V
1,1,2,2-Tetrachloroethane - P, V
Tetrahydrofuran - I/R, V
Thiourea
Thiram
Tribromomethane - P
1,2,4-Trichlorobenzene - P
1,1,2-Trichloroethane - P, V
2,4,6-Trichlorophenol - P
1,2,3-Trichloropropane
Vinyl Chloride - P, I/R, V

P = CWA priority pollutant
I/R = Ignitable or reactive compound
V = Volatile compound

TABLE 2-2. LIST OF TIER 1, 2, 2A, AND PESTICIDE POLLUTANTS FOR THE DSS (Continued)

Tier 2A - Additional RCRA Pollutants Discharged by Organics Plants (20 Pollutants)

Acenaphthylene - P
Acrylamide
Acrylic Acid - I/R
Acrylonitrile - P, I/R, V
Anthracene - P
Benzal Chloride
Benzotrichloride - I/R
2-Chlorophenol - P
Dibromomethane - V
3,3-Dimethoxy Benzidine
2,4-Dinitrophenol - P
Ethylene Thiourea
Maleic Hydrazide
Methanethiol - I/R, V
p-Nitroaniline - I/R
Phosgene - V
Phthalic Anhydride
Styrene - I/R, V
Toluene Diamine
Vanadium Pentoxide

Pesticides List - Representative Sample of Pesticides Used and Produced in U.S. (38 Pollutants)

Alachlor
Aldicarb
Aldrin - P
Antu
Atrazine
Bromacil
Captan
Carbofuran
Chlordane - P
Chlorobenzilate
2,4-D
2,4-DB
Diazinon
Dichlorvos
Dicofol
Dinoseb
Diphenamid
Disulfoton
Diuron
Endrin - P
Fenthion
Ferbam
Folex
MCPA
Methoxychlor
Mevinphos
Naled
Naptalam
Oxamyl
Parathion
Parathion Methyl
Phorate
Pyrethrins
Sodium Fluoroacetate
Stirofos
2,4,5-T
Toxaphene - P
Trifluralin

P = CWA priority pollutant
I/R = Ignitable or reactive compound
V = Volatile compound

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS

DSS POLLUTANTS / REGULATORY DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
Acenaphthylene	2A	CWA	A7	.	1	.	A8	.
Acetaldehyde	2	.	.	.	0	I	.	.
Acetone	1	.	.	F/S	1	I	.	.
Acetonecyanohydrin	2	.	.	.	0	.	A8	.
Acetonitrile	2	.	A7	.	2	I	A8	.
Acetophenone	2	.	.	.	0	.	A8	.
Acetyl Chloride	2	.	.	.	0	C,R	A8	.
Acrolein	2	CWA	.	.	0	.	A8	.
Acrylamide	2A	.	A7	.	1	.	A8	.
Acrylic Acid	2A	.	.	.	0	I	.	.
Acrylonitrile	2A	CWA	A7	.	3	.	A8	.
Alachlor	P	.	.	.	0	.	.	P
Aldicarb	P	.	.	.	0	.	A8	P
Aldrin	P	CWA	.	.	0	.	A8	P
Aniline	2	.	A7	.	3	I	A8	.
Anthracene	2A	CWA	A7	.	1	.	.	.
Antimony and Compounds	2	CWA	A7	.	1	.	A8	.
Antu	P	.	.	.	0	.	.	P
Arsenic and Compounds	1	CWA	A7	.	5	EP	A8	.
Atrazine	P	.	.	.	0	.	.	P
Barium and Compounds	1	.	.	.	0	EP	A8	.
Benzal Chloride	2A	.	.	.	0	.	A8	.
Benzene	2	CWA	A7	.	4	I	A8	.
p-Benzoquinone	2	.	.	.	0	.	A8	.
Benzotrichloride	2A	.	A7	.	1	C,R	A8	.
Benzyl Chloride	2	.	A7	.	2	.	A8	.
Bis-(2-Chloroethoxy) Methane	2	CWA	.	.	0	.	A8	.
Bis-(2-Chloroethyl) Ether	2	CWA	A7	.	1	.	A8	.
Bis-(2-Ethyl Hexyl) Phthalate	2	CWA	.	.	0	.	A8	.
Bromacil	P	.	.	.	0	.	.	P
Bromomethane	2	CWA	.	.	0	.	A8	.
N-Butyl Alcohol	1	.	.	F/S	1	I	.	.
Butyl Benzyl Phthalate	2	CWA	.	.	0	.	A8	.

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS (Continued)

DSS POLLUTANTS / REGULATORY DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
Cadmium and Compounds	1	CWA	A7	F/P	4	EP	A8	.
Captan	P	.	.	.	0	.	(P)	P
Carbofuran	P	.	.	.	0	.	(P)	P
Carbon Disulfide	1	.	A7	F/S	1	I	A8	.
Carbon Tetrachloride	1	CWA	A7	F/S	7	.	A8	.
Chlordane	P	CWA	A7	.	1	.	A8	P
Chlorobenzene	1	CWA	A7	F/S	4	.	A8	.
Chlorobenzilate	P	.	.	.	0	.	A8	P
Chloroethane	2	CWA	.	.	0	.	A8	.
p-Chloro-m-Cresol	2	CWA	A7	.	1	.	A8	.
Chloroform	2	CWA	A7	.	8	.	A8	.
Chloromethane	2	CWA	A7	.	3	I	A8	.
Chloronaphthalene	2	CWA	.	.	0	.	A8	.
2-Chlorophenol	2A	CWA	A7	.	1	.	A8	.
Chromium and Compounds	1	CWA	A7	F/P	1	EP	A8	.
Cresols (3 isomers)	1	.	A7	F/S	2	.	A8	.
Cumene	2	.	.	.	0	I	.	.
Cyanide	2	CWA	A7	F/P	1	.	A8	.
Cyclohexane	2	.	.	.	0	I	.	.
Cyclohexanone	1	.	.	F/S	1	I	.	.
2,4-D	P	.	.	.	0	.	A8	P
2,4-DB	P	.	.	.	0	.	.	P
Diazinon	P	.	.	.	0	.	(P)	P
Dibromomethane	2A	.	.	.	0	.	A8	.
Di-N-Butyl Phthalate	2	CWA	.	.	0	.	A8	.
1,2-Dichlorobenzene	1	CWA	A7	F/S	5	.	A8	.
1,3-Dichlorobenzene	2	CWA	A7	.	3	.	A8	.
1,4-Dichlorobenzene	2	CWA	A7	.	3	.	A8	.
Dichlorodifluoromethane	1	.	A7	F/S	1	.	A8	.
1,1-Dichloroethane	2	CWA	A7	.	1	.	A8	.
1,2-Dichloroethane	2	CWA	A7	.	7	.	A8	.
1,1-Dichloroethylene	2	CWA	A7	.	5	.	A8	.
Trans-1,2-Dichloroethylene	2	CWA	A7	.	1	.	A8	.

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS (Continued)

DSS POLLUTANTS / REGULATORY DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
2,4-Dichlorophenol	2	CWA	A7	.	2	.	A8	.
1,2-Dichloropropane	2	CWA	A7	.	0	.	A8	.
Dichloropropanol	2	.	A7	.	1	.	A8	.
Dichlorvos	P	.	.	.	0	.	(P)	P
Dicofol	P	.	.	.	0	.	.	P
Diethyl Phthalate	2	CWA	.	.	0	.	A8	.
1,3-Dimethoxy benzidine	2A	.	.	.	0	.	A8	.
Dimethylamine	2	.	.	.	0	I	.	.
2,4-Dimethyl Phenol	2	CWA	A7	.	2	.	A8	.
Dimethyl Phthalate	2	CWA	.	.	0	.	A8	.
2,4-Dinitrophenol	2A	CWA	A7	.	1	.	A8	.
Dinoseb	P	.	.	.	0	.	A8	P
Di-N-Octyl Phthalate	2	CWA	.	.	0	.	A8	.
1,4-Dioxane	2	.	.	.	0	.	A8	.
Diphenamid	P	.	.	.	0	.	.	P
Diphenyl Amine	2	.	A7	.	2	.	A8	.
Disulfoton	P	.	.	.	0	-	A8	P
Diuron	P	.	.	.	0	.	A8	P
Endrin	P	CWA	.	.	0	.	A8	P
Epichlorohydrin	2	.	A7	.	1	.	A8	.
Ethyl Acetate	1	.	.	F/S	1	I	.	.
Ethyl Benzene	1	CWA	.	F/S	1	I	.	.
Ethylene Oxide	2	.	.	.	0	I	A8	.
Ethylene Thiourea	2A	.	.	.	0	.	A8	.
Ethyl Ether	1	.	.	F/S	1	I	.	.
Fenthion	P	.	.	.	0	.	(P)	P
Ferbam	P	.	.	.	0	.	.	P
Folex	P	.	.	.	0	.	.	P
Formaldehyde	2	.	A7	.	4	.	A8	.
Formic Acid	2	.	A7	.	2	C	A8	.
Furan	2	.	.	.	0	I	.	.
Furfural	2	.	.	.	0	I	.	.
Hexachloro-1,3-Butadiene	2	CWA	A7	.	4	.	A8	.

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS (Continued)

DSS POLLUTANTS / REGULATORY / DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
Hexachloroethane	2	CWA	A7	.	4	.	A8	.
Hydrazine	2	.	.	.	0	R	A8	.
Isobutanol	1	.	A7	F/S	1	I	A8	.
Lead and Compounds	1	CWA	A7	.	13	EP	A8	.
Maleic Hydrazide	2A	.	.	.	0	.	A8	.
Mercury and Compounds	1	CWA	A7	.	2	EP	A8	.
Mathanethiol	2A	.	.	.	0	I	A8	.
MCPA	P	.	.	.	0	.	.	P
Methanol	1	.	.	F/S	1	I	.	.
Methoxychlor	P	.	.	.	0	.	A8	P
Methyl Ethyl Ketone	1	.	A7	F/S	1	I	A8	.
Methyl Isobutyl Ketone	1	.	.	F/S	1	I	.	.
Methylene Chloride	1	CWA	A7	F/S	5	.	A8	.
Mevinphos	P	.	.	.	0	.	(P)	P
Naled	P	.	.	.	0	.	(P)	P
Naphthalene	2	CWA	A7	.	5	.	A8	.
Naptalam	P	.	.	.	0	.	.	P
Nickel and Compounds	2	CWA	A7	F/P	1	.	A8	.
p-Nitroaniline	2A	.	.	.	0	.	A8	.
Nitrobenzene	1	CWA	A7	F/S	4	.	A8	.
2-Nitropropane	2	.	.	.	0	I	.	.
N-Nitrosodimethyl Amine	2	CWA	.	.	0	.	A8	.
Oxamyl	P	.	.	.	0	.	.	P
Parathion	P	.	.	.	0	.	A8	P
Parathion Methyl	P	.	.	.	0	.	A8	P
PCB	2	CWA	.	.	0	.	A8	.
Pentachloroethane	2	.	.	.	1	.	A8	.
Pentachlorophenol	2	CWA	A7	.	3	.	A8	.
Phenol	2	CWA	A7	.	4	.	A8	.
Phenylene Diamine	2	.	A7	.	3	.	A8	.
Phorate	P	.	A7	.	2	.	A8	P
Phosgene	2A	.	.	.	0	.	A8	.
Phthalic anhydride	2A	.	A7	.	4	.	A8	.

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS (Continued)

DSS POLLUTANTS / REGULATORY DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
2-Picoline	2	.	A7	.	1	.	A8	.
Pyrethrins	P	.	.	.	0	.	.	P
Pyridine	1	.	A7	F/S	2	I	A8	.
Resorcinol	2	.	.	.	0	.	A8	.
Selenium and Compounds	1	CWA	.	.	0	EP	A8	.
Silver and Compounds	1	CWA	.	.	0	EP	A8	.
Sodium Fluoroacetate	P	.	.	.	0	.	A8	P
Stirofos	P	.	.	.	0	.	.	P
Styrene	2A	.	.	.	0	.	(P)	.
2,4,5-T	P	.	.	.	0	.	A8	P
Tetrachlorobenzene	2	.	A7	.	2	.	A8	.
1,1,1,2-Tetrachloroethane	2	.	A7	.	5	.	A8	.
1,1,2,2-Tetrachloroethane	2	CWA	A7	.	6	.	A8	.
Tetrachloroethylene	1	CWA	A7	F/S	3	.	A8	.
Tetrahydrofuran	2	.	.	.	0	I	.	.
Thiorea	2	.	.	.	0	.	A8	.
Thiram	2	.	.	.	0	.	A8	.
Toluene	1	CWA	A7	F/S	4	I	A8	.
Toluene Diamine	2A	.	A7	.	1	.	A8	.
Toxaphene	P	CWA	A7	.	0	.	(P)	P
Tribromomethane	2	CWA	.	.	0	.	A8	.
1,2,4-Trichlorobenzene	2	CWA	A7	.	1	.	A8	.
1,1,1-Trichloroethane	1	CWA	A7	F/S	9	.	A8	.
1,1,2-Trichloroethane	2	CWA	A7	.	6	.	A8	.
Trichloroethylene	1	CWA	A7	F/S	6	.	A8	.
Trichlorofluoromethane	1	.	A7	F/S	1	.	A8	.
2,4,6-Trichlorophenol	2	CWA	A7	.	3	.	A8	.
1,2,3-Trichloropropane	2	.	A7	.	0	.	A8	.
1,1,2-Trichloro-1,2,2-Trifluoroethane	1	.	A7	F/S	1	.	A8	.
Trifluralin	P	.	.	.	0	.	(P)	P

TABLE 2-3. REGULATORY STATUS OF DSS POLLUTANTS (Continued)

DSS POLLUTANTS / REGULATORY DESIGNATIONS	DSS PROJECT STATUS[1]	CWA PRIORITY POLLUTANT[2]	RCRA APPENDIX VII CONSTITUENT[3]	RCRA F-CODE SOLVENT/PLATING WASTE[4]	NUMBER OF RCRA F,K-CODE LISTING	RCRA CHARACTERISTIC WASTE[5]	RCRA APPENDIX VIII CONSTITUENT[6]	SELECTED PESTICIDES[7]
Vanadium Pentoxide	2A	.	.	.	0	.	A8	.
Vinyl Chloride	2	CWA	A7	.	5	.	A8	.
Xylenes (3 isomers)	1	.	.	F/S	1	I	.	.
Pollutant Totals	165	67	74	30	N/A	41	121	38

Key:

1
1=DSS Tier 1 pollutant
2=DSS Tier 2 pollutant
2A=DSS Tier 2A pollutant
P=DSS Pesticide pollutant

2
CWA=CWA priority pollutant

3
A7=RCRA Appendix VII hazardous constituent

4
F/S=F-code solvent waste
F/P=F-code plating waste

5
I=Ignitable waste
R=Reactive waste
C=Corrosive waste
EP=EP toxic waste

6
A8=RCRA Appendix VIII hazardous constituent
(P)=Proposed RCRA Appendix VIII hazardous constituent

7
P=Selected pesticide

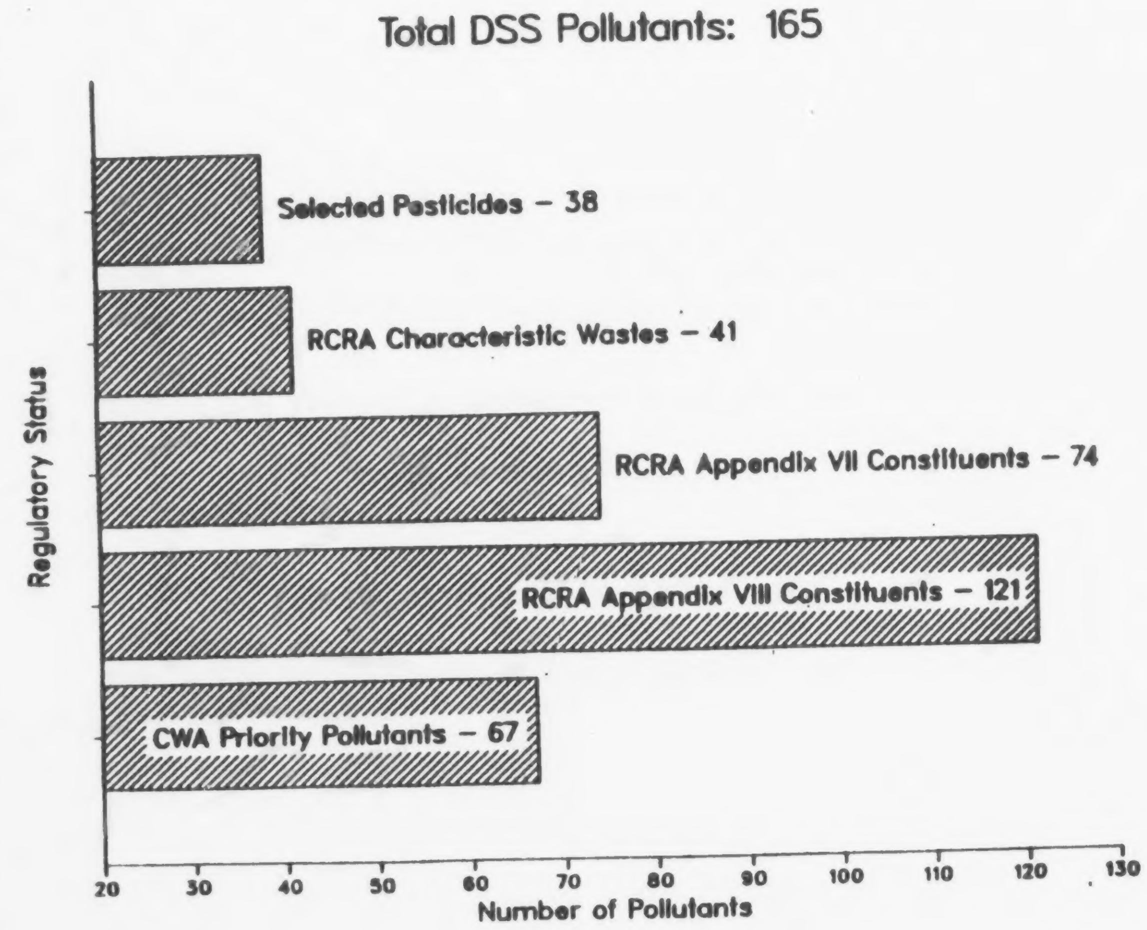

FIGURE 2-2. PROFILE OF REGULATORY STATUS OF DSS POLLUTANTS[1]

[1] Because of double-counting (where same pollutant appears on more than one list), total for Figure is 341, rather than 165.

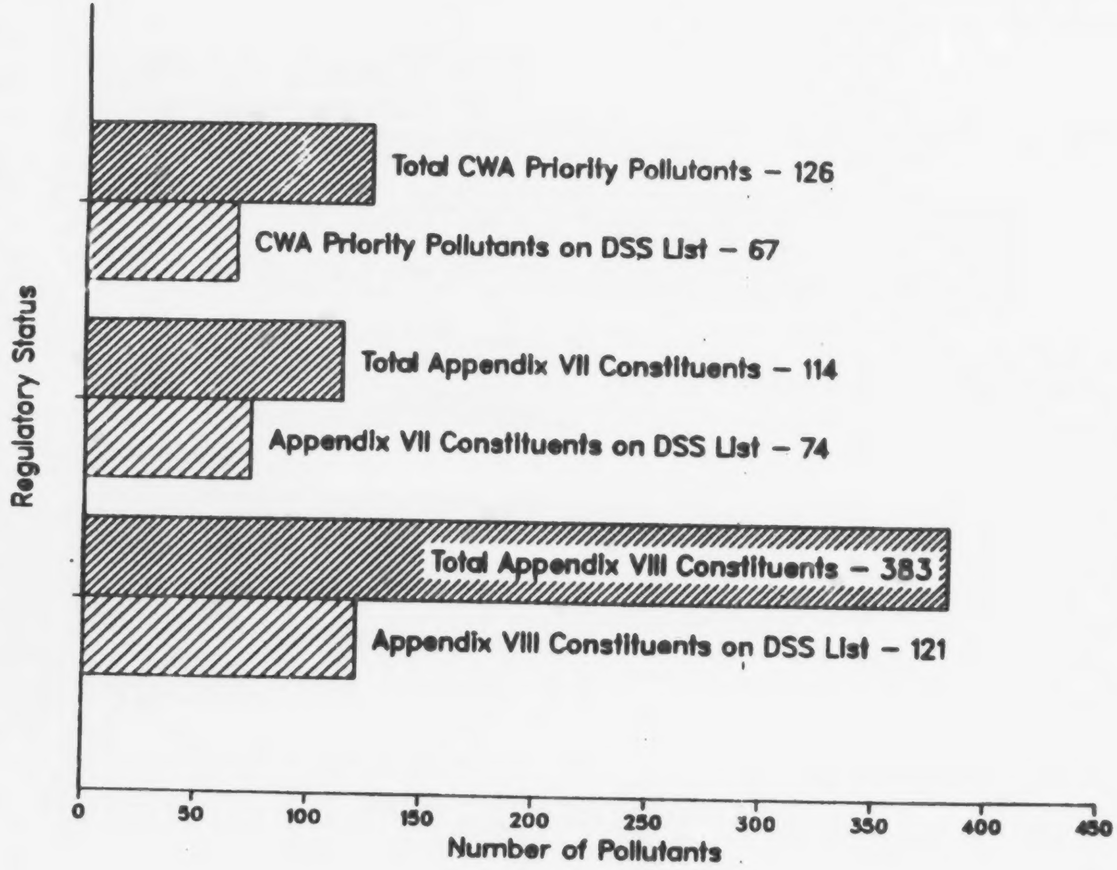

FIGURE 2-3. REPRESENTATION OF KEY RCRA AND CWA POLLUTANT LISTS ON DSS POLLUTANT LIST[1]

[1] Because of double-counting (where same pollutant appears on more than one list), total for Figure is 262, rather than 165.

In the following chapters, the DSS pollutants are discussed as "nonpriority hazardous constituents" and "priority hazardous constituents." The nonpriority constituents are all constituents with the exception of the CWA priority pollutants. Conversely, the priority hazardous constituents are the CWA priority pollutants. Both classifications discuss the metals and organics.

CHAPTER 3

TYPES, QUANTITIES, AND SOURCES OF HAZARDOUS WASTES DISCHARGED TO POTWs

3. TYPES, QUANTITIES, AND SOURCES OF HAZARDOUS WASTES DISCHARGED TO POTWS

This chapter describes the types, quantities, and sources of hazardous wastes and constituents discharged to publicly owned treatment works (POTWs). To provide a comprehensive profile of current and future discharge practices, the chapter presents data for 47 different industrial categories, ranging from the largest hazardous waste generators, such as the organic chemicals and petroleum refining industries, to small quantity generators (SQGs), such as laundries and motor vehicle services. Thus, these 47 industrial categories include the traditional Natural Resources Defense Council (NRDC) Consent Decree industries as well as new, emerging industries (e.g., waste reclamation, waste treatment) and smaller service-oriented industries.

As described in Chapter 2, this study is based mainly on the loadings to POTWs of individual Resource Conservation and Recovery Act (RCRA) waste constituents (e.g., benzene, cyanide) rather than generic waste types (e.g., spent solvents, still bottoms). However, where Environmental Protection Agency (EPA) data sources provided information on the discharge of RCRA characteristic and listed hazardous wastes to POTWs, this information has been included in Chapter 3.

To evaluate the efficiency of existing and proposed controls on the discharge of hazardous waste constituents, the analysis in this chapter presents discharge estimates for three treatment scenarios: raw waste, current treatment, and treatment after compliance with Pretreatment Standards for Existing Sources (PSES). The raw waste scenario assumes the discharge of untreated wastewater; the current treatment scenario assumes the discharge of wastewater at existing treatment levels; and the treatment after PSES scenario projects pollutant loadings following the installation of treatment necessary to meet National categorical pretreatment standards.

3.1 BACKGROUND AND METHODOLOGY FOR ANALYSIS OF HAZARDOUS WASTE TYPES, QUANTITIES, AND SOURCES

The following section outlines the methodology used to analyze types, quantities, and sources of hazardous wastes discharged to POTWs. This methodology involved several steps, including the development of an industry categorization scheme; the evaluation of pertinent EPA Office of Water (OW), EPA Office of Solid Waste (OSW), State, and local data sources; the compilation of discharge data for each industrial category; and the analysis and interpretation of data for each industrial category. The first two methodological steps -- development of an industry categorization scheme and review of data sources -- are described below.

3.1.1 Methodology for Development of an Industry Categorization Scheme

The initial step in determining possible sources of hazardous wastes discharged to POTWs was to develop an industry categorization scheme. This procedure entailed identifying the types of industrial facilities that generate, transport, treat, store, or dispose any significant quantity (i.e., greater than 100 kg/mo) of hazardous waste. Identification of these industrial categories involved reviewing several industrial data sources:

- Documentation supporting effluent guidelines rulemakings undertaken by EPA's Industrial Technology Division (ITD) for the NRDC consent decree industries and other "secondary" industries
- EPA/OSW report, National Small Quantity Hazardous Waste Generator Survey, which contains industrial groups for SQGs
- Other EPA/OSW studies such as, Economic Impact Analysis of Subtitle C RCRA of 1976, and National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981
- Standard Industrial Classification Code Manual
- Industrial waste survey data from various State and local pretreatment programs.

Based on the analysis of these data sources, a final list of 47 industrial categories was developed. Table 3-1 lists these 47 industrial categories.

Many of the Domestic Sewage Study (DSS) industrial categories correspond well with industry groupings used by ITD during various effluent guidelines rulemakings. In addition, several new industrial categories were added to the list based on the review of the data sources cited above. The use of ITD

TABLE 3-1. DSS INDUSTRIAL CATEGORIES

Adhesives and Sealants
Battery Manufacturing
Coal, Oil, Petroleum Products, and Refining
Construction Industry (Contract and Special Trade)
Cosmetics, Fragrances, Flavors, and Food Additives
Dye Manufacture and Formulation
Electric Generating Power Plants and Electric Distribution Services
Electrical and Electronic Components
Electroplating/Metal Finishing
Equipment Manufacture and Assembly
Explosives Manufacture
Fertilizer Manufacture
Food and Food By-Products Processing
Gum and Wood Chemicals, Varnishes, Lacquers, and Related Oils
Hazardous Waste Site Cleanup
Industrial and Commercial Laundries
Ink Manufacture and Formulation
Inorganic Chemicals Manufacturing
Iron and Steel Manufacturing and Forming
Laboratories and Hospitals
Leather Tanning and Finishing
Miscellaneous Chemical Formulation
Motor Vehicle Services
Nonferrous Metals Forming
Nonferrous Metals Manufacturing
Organic Chemicals Manufacturing
Paint Manufacture and Formulation
Pesticides Formulation
Pesticides Manufacturing
Pharmaceutical Manufacturing
Photographic Chemicals and Film Manufacturing
Plastics Molding and Forming
Plastics, Resins, and Synthetic Fibers Manufacturing
Porcelain Enameling
Printing and Publishing
Pulp and Paper Mills
Rubber Manufacture and Processing
Service Related Industries (other than motor vehicle services)
Soap and Detergents, Cleaning Preparations, and Waxes Manufacture and Formulation
Stone, Clay, Glass, Concrete, and Other Mineral Products
Textile Mills
Timber Products Processing
Transportation Services
Waste Reclamation Services
Waste Treatment and Disposal Services
Wholesale and Retail Trade
Wood Furniture Manufacture and Refinishing

categories enabled more efficient use of data collected by ITD in support of their rulemakings. In some cases, ITD categories were subdivided or combined for this study. Examples of modifications to ITD industry categories include:

- Expanding the petroleum refining category to include the production of coal and oil products and renaming the category coal, oil, petroleum products, and refining.
- Combining the coil coating category with the electroplating/metal finishing category because of the similiarity of their processes.
- Combining the aluminum, copper, and nonferrous metals forming categories into one category entitled nonferrous metals forming.
- Dividing the metals molding and casting category into its ferrous and nonferrous metals subcategories. The nonferrous metals subcategories were included in the nonferrous metals manufacturing category and the ferrous metals subcategories were included in the iron and steel manufacturing and forming category.
- Dividing the organic chemicals, plastics, and synthetic fibers category into three categories, including dye manufacture and formulation; organic chemicals manufacturing; and plastics, resins, and synthetic fibers manufacturing categories.
- Including the photographic processing category as a subcategory under the service-related industries category.

Subcategory assignment also relied substantially on schemes created by ITD during effluent guidelines rulemakings. Development of industry subcategories allowed greater discrimination within the larger industrial categories and provided greater flexibility in the incorporation of information from various data sources and presentation of results. However, some subcategorization schemes used by ITD in effluent guidelines rulemakings were not used or were amended for purposes of this study. Examples of modification to ITD subcategories include:

- Moving the car wash subcategory from the auto and other laundry category to the motor vehicle services category
- Expanding the electroplating/metal finishing subcategories to include other nonregulated metal fabrication and metal products manufacturing processes

- Combining subcategories in the inorganic chemicals category, which are organized by specific inorganic compounds produced, into major compound groups
- Expanding the leather tanning and finishing and pulp and paper subcategories to include processing of the finished product.

Finally, Standard Industrial Classification (SIC) codes were assigned to each industrial category and subcategory. SIC codes describe the primary activity at a facility based on the principal product or group of products produced or distributed, or services rendered. Assignment of SIC codes to industrial categories and subcategories was an important step in this study since SIC codes are a common element in most industrial data sources. While SIC codes received considerable emphasis from ITD during rulemakings, numerous SIC codes were added to industry categories and subcategories to ensure that data from other sources, primarily EPA/OSW and State and local data sources, could be incorporated into the industry categorization scheme adopted for this study. Appendix C presents the list of industrial categories, subcategories, and SIC codes for each subcategory. The industry categorization scheme shown in Appendix C provides the basis for the organization of the wastewater and hazardous waste data gathered and analyzed for this study.

3.1.2 Summary and Evaluation of Major Data Sources

The major industrial data sources used in the assessment of types, quantities, and sources of hazardous waste discharged to POTWs are shown in Table 3-2. This table also provides an analysis of the strengths and weaknesses of each data source as it relates to industry background information and wastewater discharge characteristics. Table 3-3 presents a similar analysis of strengths and weaknesses of these data sources as they relate to specific industrial categories.

Table 3-2 includes EPA/OSW, EPA/OW, and State and local data sources. The OSW data sources consisted of the National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981, the Hazardous Waste Data Management System (HWDMS), the National Small Quantity Hazardous Waste Generator Survey, and the Industry Studies Data Base (ISDB).

TABLE 3-2. STRENGTHS AND WEAKNESSES OF MAJOR INDUSTRIAL DATA SOURCES

DATA ELEMENTS / MAJOR INDUSTRIAL DATA SOURCES	DATA ON INDUSTRIAL DISCHARGERS								
	Number of Hazardous Waste Generators	Hazardous Waste Type/ Quantity	Number of Indirect Dischargers	Hazardous Waste Type/Quantity Discharged to POTW	RCRA/Priority Pollutants Detected	RCRA/Priority Pollutant Concentration/Mass	Other RCRA Pollutants Detected	Other RCRA Pollutant Concentration/Mass	Treatment/Removals
OSW National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981	2	2	*	*	*	*	*	*	*
OSW Hazardous Waste Data Management System	2	2	*	*	*	*	*	*	*
OSW National Small Quantity Hazardous Waste Generator Survey	1	1	1	1	2	2	2	2	2
OSW Industry Studies Data Base	1	1	1	1	1	1	1	1	2
OW/ITD Organic Chemicals/Pesticide Data Base	2	2	1	1	1	1	*	*	1
OW/ITD Development Documents	2	2	1	1	1	1	*	*	1
OW Paragraph 4(c) Program	*	*	*	*	1	*	1	*	*
Seattle Metro Toxicant Pretreatment Planning Study	*	*	*	*	1	1	1	1	*
Categorical Standards Compliance Monitoring Reports	2	2	*	2	2	2	*	*	2
POTW Industrial Waste Surveys and Compliance Monitoring Data	*	*	2	2	2	2	2	2	*
State Pretreatment/Hazardous Waste Data	2	2	1	1	1	1	2	2	*
OW Monitoring and Data Support Industry Status Sheets	*	*	1	2	1	1	*	*	1

KEY: 1 = Substantial data
2 = Limited data, or major assumptions required for use
* = Little or no data

TABLE 3-3. ADEQUACY OF AVAILABLE DATA SOURCES FOR EVALUATION OF DSS INDUSTRIAL CATEGORIES

DATA ELEMENTS / INDUSTRIAL DATA SOURCES	DATA ON INDUSTRIAL DISCHARGERS								
	Number of Hazardous Waste Generators	Hazardous Waste Types Generated	Hazardous Waste Quantities Generated	Number of Indirect Dischargers	RCRA/Priority Pollutants Detected	RCRA/Priority Pollutant Concentration/Mass	Other RCRA Pollutants Detected	Other RCRA Pollutant Concentration/Mass	Treatment/Removals
Adhesives and Sealants	1	1	*	1	1	1	2	*	1
Battery Manufacturing	1	1	2	1	1	1	2	*	1
Coal, Oil, Petroleum Products, and Refining	1	1	2	1	1	1	2	*	1
Construction Industry (Contract and Special Trade)	1	2	2	2	*	*	*	*	*
Cosmetics, Fragrances, Flavors, and Food Additives	1	2	2	2	*	*	*	*	*
Dye Manufacture and Formulation	1	1	1	1	1	1	1	1	1
Electric Generation Power Plants and Electric Distribution Services	2	1	2	2	2	2	*	*	*
Electrical and Electronic Components	1	1	2	1	1	1	2	*	1
Electroplating/Metal Finishing	1	1	2	1	1	1	2	*	1
Equipment Manufacture and Assembly	1	1	2	*	*	*	2	*	1
Explosives Manufacture	1	1	2	1	1	1	2	*	1
Fertilizer Manufacture	1	1	*	2	*	*	*	*	*
Food and Food By-Products Processing	1	1	*	2	*	*	*	*	*
Gum and Wood Chemicals, Varnishes, Lacquers and Related Oils	1	1	2	1	1	1	2	*	1
Hazardous Waste Site Clean-Up	2	*	*	*	*	*	*	*	*
Industrial and Commercial Laundries	1	2	2	1	1	1	2	*	1
Ink Manufacture and Formulation	1	1	2	1	1	1	2	*	1
Inorganic Chemicals Manufacturing	1	1	2	1	1	1	2	*	1
Iron and Steel Manufacture and Forming	1	1	2	1	1	1	2	*	1
Laboratories and Hospitals	1	2	2	2	*	*	*	*	*
Leather Tanning and Finishing	1	1	2	1	1	1	2	*	*
Miscellaneous Chemical Formulation	1	2	2	2	*	*	*	*	*

1 = Substantial Data
2 = Limited Data or Major Assumption(s) Required for Use
* = Little or No Data

TABLE 3-3. ADEQUACY OF AVAILABLE DATA SOURCES FOR EVALUATION OF DSS INDUSTRIAL CATEGORIES (Continued)

DATA ELEMENTS / INDUSTRIAL DATA SOURCES	DATA ON INDUSTRIAL DISCHARGERS								
	Number of Hazardous Waste Generators	Hazardous Waste Types Generated	Hazardous Waste Quantities Generated	Number of Indirect Dischargers	RCRA/Priority Pollutants Detected	RCRA/Priority Pollutant Concentration/Mass	Other RCRA Pollutants Detected	Other RCRA Pollutant Concentration/Mass	Treatment/Removals
Motor Vehicle Services	1	2	2	2	*	*	*	*	*
Nonferrous Metals Forming	1	1	2	1	1	1	*	*	1
Nonferrous Metals Manufacturing	1	1	*	1	1	1	2	*	1
Organic Chemicals Manufacturing	1	1	1	1	1	1	1	1	1
Paint Manufacture and Formulation	1	1	2	1	1	1	2	*	1
Pesticides Formulation	1	1	2	1	1	1	2	2	1
Pesticides Manufacturing	1	1	1	1	1	1	1	1	1
Pharmaceutical Manufacturing	1	1	2	1	1	1	2	*	1
Photographic Chemicals and Film Manufacturing	1	1	*	1	1	1	2	*	1
Plastics Molding and Forming	1	1	2	1	1	1	2	*	1
Plastics, Resins and Synthetic Fibers Manufacturing	1	1	1	1	1	1	1	1	1
Porcelain Enameling	1	1	2	1	1	1	2	*	1
Printing and Publishing	1	1	2	1	1	1	2	*	1
Pulp and Paper Mills	1	1	2	1	1	1	2	*	1
Rubber Manufacture and Processing	1	1	2	2	2	2	2	*	1
Service Related Industries (other than motor vehicle services)	1	2	2	2	*	*	*	*	*
Soap and Detergents, Cleaining Preparations and Waxes Manufacture and Formulation	1	1	*	2	*	*	2	*	*
Stone, Clay, Class, Concrete, and Other Mineral Products	1	1	*	2	2	2	*	*	*
Textile Mills	1	1	2	1	1	1	2	*	1
Timber Products Processing	1	1	*	1	1	1	2	*	1
Transportation Services	1	2	*	2	*	*	*	*	*
Waste Reclamation Services	2	*	*	*	*	*	*	*	*
Waste Treatment and Disposal Services	2	*	*	*	*	*	*	*	*
Wholesale Trade Industry	1	2	2	2	*	*	*	*	*
Wood Furniture Manufacture and Refinishing	1	2	2	2	*	*	*	*	*

1 = Substantial Data
2 = Limited Data or Major Assumption(s) Required for Use
* = Little or No Data

Generally, the EPA/OSW data sources provided a substantial amount of data on the types and quantities of hazardous wastes generated, treated, stored, or disposed by an industrial category. Except for the SQG survey and the ISDB, however, these same data sources provided little information on the number of indirect discharging facilities and quantities of hazardous wastes discharged to POTWs by these facilities. The SQG survey provided estimates by industrial category for the types and quantities of hazardous wastes being discharged to POTWs, but only for SQGs (i.e., less than 1,000 kg/mo). (The HSWA of 1984 changed the definition of SQGs from 1,000 kg/mo to 100 kg/mo. The SQG Survey was conducted prior to the amendments.) The ISDB provided extensive data on hazardous wastes and constituents discharged to POTWs, but only for a small number of industrial categories (i.e., organic chemicals manufacturing; plastics, resins, and synthetic fibers manufacturing; dye manufacture and formulation; and pesticides manufacture). The ISDB was the only data source that provided substantial data on loadings of hazardous constituents that are not priority pollutants under the Clean Water Act (CWA).

The EPA/OW data sources shown in Table 3-2 contained general background information as well as loadings for a limited number of hazardous constituents in a majority of the DSS industrial categories. Also, EPA/OW discharge data generally extended only to constituents that are also CWA priority pollutants. The limited data reflect the scope of EPA/OW effluent guidelines rulemakings, which focused on control of priority pollutant discharges by the various industrial categories. EPA/OW did attempt, through the CWA Paragraph 4(c) Program, to identify nonpriority pollutants present in process wastewaters discharged to POTWs by various industrial categories (see Section 3.3.4.2). Data collected for this program were used to assess the possible presence of nonpriority hazardous pollutants in industrial wastewaters.

State and local data sources provided useful information on hazardous constituents discharged to POTWs by facilities within the various industrial categories. With some exceptions (e.g., Seattle Metro), State and local data emphasized hazardous constituents that are also priority pollutants. Still, these data sources often provided information on industrial categories that were not covered by EPA/OW and EPA/OSW data sources.

Table 3-3 summarizes the relative strengths and weaknesses of different data sources for specific industrial categories. As indicated in this table, these data sources provided extensive information on some industrial categories (e.g., organic chemicals manufacturing) and little information on other categories (e.g., hazardous waste site cleanups). Based on available data sources for specific industrial categories, the 47 industrial categories were divided into the following three groups:

- Organic chemicals industrial categories
- Selected consent decree industrial categories (including the organic chemicals industrial categories)
- Other industrial categories potentially discharging hazardous wastes to POTWs.

The organic chemicals industrial categories group, which accounts for a substantial proportion of all organic hazardous wastes generated, is composed of four industries: (1) dye manufacture and formulation; (2) organic chemicals manufacture; (3) plastics, resins, and synthetic fibers manufacture; and (4) pesticides manufacture. Data on loadings of both priority and nonpriority hazardous constituents discharged by the organic chemicals industrial categories were gathered from two unique data sources:

- Data bases supporting ongoing EPA/OW effluent guidelines rulemakings for the organic chemicals; plastics, resins, and synthetic fibers; and pesticides manufacturing categories
- The EPA/OSW ISDB, which incorporates data from RCRA 3007 questionnaires and sampling/analysis results.

Because of the accurate and extensive information on both RCRA wastes and priority hazardous constituents discharged by the organic chemicals industries, these industries as a group were analyzed.

The selected consent decree industrial categories are composed of 30 major industrial categories that have been regulated, or considered for regulation, by EPA/OW as required by the CWA, and in accordance with the terms of the 1976 NRDC Consent Decree. As mentioned above, the selected consent decree industries group includes the four organic chemicals industrial categories. Existing data sources for these selected consent decree categories contain substantial data on loadings of priority hazardous constituents, but only limited data on loadings of listed and characteristic hazardous wastes and nonpriority hazardous constituents. The remaining 17 industrial categories primarily consist of service-related industries. EPA/OW and EPA/OSW data sources generally contained little information on these industrial categories. Consequently, a variety of data sources were utilized to assess potential hazardous waste discharges from these industrial categories.

3.1.3 Organization of the Chapter

The remainder of the chapter is divided into six sections. Section 3.2 presents and analyzes discharge data for the major organic chemicals industrial categories. Section 3.3 presents and analyzes basic characteristic and hazardous waste data for 30 selected consent decree industries. For comparative purposes, data for the four organics industrial categories presented in Section 3.2 also are incorporated into this section. Section 3.4 presents information from various data sources for 17 other industrial categories and evaluates the potential for hazardous waste and constituent discharges to POTWs from these industrial categories. Section 3.5 evaluates the production and use of selected hazardous constituents (primarily RCRA solvents) in an attempt to determine the probable sources of pollutants known or believed to be common in POTW influent wastewaters. Section 3.6 estimates hazardous constituent loadings to POTWs from residential sources. Finally, Section 3.7 summarizes and evaluates the hazardous pollutant loadings from the major industry categories.

3.2 TYPES AND QUANTITIES OF HAZARDOUS WASTES AND CONSTITUENTS DISCHARGED BY THE ORGANIC CHEMICALS INDUSTRIAL CATEGORIES

The organic chemicals industries have been the focus of numerous studies and regulatory initiatives undertaken by both EPA's OW and OSW. The Agency has evaluated the organics industries in detail because they are composed of numerous large and complex facilities that handle an array of chemical intermediates, products, and wastes posing significant environmental concerns if improperly managed. For the study's purposes, the organic chemicals industry encompasses the following four categories:

- Dye Manufacture and Formulation
- Organic Chemicals Manufacturing
- Pesticides Manufacturing
- Plastics, Resins, and Synthetic Fibers Manufacturing.

The pesticides manufacturing category does not include the pesticide formulation segment, which is addressed as a separate category in Section 3.3 of this report.

The selection of these four categories for separate analysis should not be interpreted that these categories are the only significant sources of organic hazardous constituents. Numerous other industrial categories, such as the petroleum refining, pharmaceutical manufacturing, and electroplating/metal finishing categories, discharge large quantities of organic hazardous constituents to POTWs. These other categories are examined in Section 3.3.

The analysis presented in Section 3.2 has two major objectives. First, it estimates hazardous constituent loadings of both priority and nonpriority pollutants to POTWs from these industries. For comparative purposes, these results also have been incorporated into Section 3.3 of this chapter, which presents hazardous constituent loadings estimates for 30 selected consent decree categories, including the four organics categories. Second, the ISDB was used to estimate generation and discharge rates for characteristic and listed hazardous wastes. In estimating hazardous constituent loadings, the analysis blends data derived from major EPA/OSW and EPA/OW data bases on these industries. Consequently, the discussion of industry estimates identifies and explains areas of major agreement or disagreement in estimates derived from the two data sources. The remainder of Section 3.2 briefly discusses the significance of the organics industries, describes methodologies used to project hazardous waste and constituent loadings, and presents study findings for the organics industries.

3.2.1 Background and Methodology for Evaluation of the Organic Chemicals Industrial Categories

A 1984 EPA report, National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981, estimated that the chemical and petroleum refining industry (SIC 28-29) generated 71 percent of all RCRA hazardous wastes generated nationally in 1981. Other data sources, such as the EPA Hazardous Waste Data Management System, also suggest the predominance of these industries as hazardous waste generators. Many of the chemical products formulated by this industry ultimately become the hazardous constituents discharged by the remaining industries. Previous EPA/OW studies also have established that the organics industries discharge substantial quantities of toxic pollutants to POTWs. In its evaluation of the National Pretreatment Program, the pretreatment regulatory impact analysis (RIA) estimated that the organics industries discharge 38 percent of all priority pollutants and 56 percent of all organic priority pollutants discharged to POTWs.

The need for effective regulation of these industries is reflected in current EPA/OW and EPA/OSW regulatory programs. The proposed pretreatment standards for the organic chemicals and plastics and synthetic fibers industry (OCPSF) (which includes three DSS industrial categories: organic chemicals; plastics, resins, and synthetic fibers; and dye manufacture and formulation) published in the Federal Register on July 17, 1985 (50 FR 29068) reported that 42 percent of the approximately 1,000 OCPSF facilities discharged wastes to POTWs at an estimated average daily process flow of 0.24 million gallons per day (mgd) per plant. Research used to develop these proposed standards found that "as a result of the wide variety and complexity of raw materials and processes used and of products manufactured in the OCPSF industry, an exceptionally wide variety of pollutants are found in the wastewaters of this industry." Furthermore, 39 percent of the indirect dischargers surveyed reported either no treatment or no treatment beyond equalization and neutralization; 47 percent utilized some physical/chemical treatment; and 14 percent employed biological treatment of wastewaters. Final regulations for the Pesticides Manufacturing and Formulation categories were promulgated in the Federal Register on October 4, 1985 (50 FR 40672).

In EPA's OSW, organic chemical manufacturing wastes have received considerable attention in the Hazardous Waste Identification and Listing Program over the last 4 years. A survey of proposed hazardous waste listings and listings currently being evaluated for possible proposal for 23 product/processes showed that only 5 out of 84 wastes are proposed for listing solely because of toxic metal content. Seven wastes are being considered for listing due to both metal and organic toxics, while 79 wastes are proposed for listing because of their toxic organic constituents alone. These proposed listings reflect EPA/OSW's current emphasis on the organics industries.

Key data sources for the evaluation of the organics industries were the OSW ISDB and the OW/ITD data bases. Together, these data bases allowed extensive characterization of hazardous waste generation and discharge practices for the four organic chemicals industrial categories. Table 3-4 provides an overview of the types of data contained in the ISDB and ITD data bases. As indicated in this table, the ISDB contains information on POTW loadings of priority and nonpriority hazardous constituents and POTW loadings of characteristic and listed hazardous wastes, but does not contain data on treatment and removal of hazardous wastes and constituents. By comparison, the ITD data bases for OCPSF and pesticide rulemakings contain information on POTW loadings of priority hazardous constituents and on treatment and removal of these constituents, but do not contain information on loadings of non-priority hazardous constituents, or characteristic and listed hazardous wastes. The ISDB and ITD data bases provided overlapping data sources only for loadings of priority hazardous constituents. All other data elements were derived exclusively from one of the two data bases.

3.2.1.1 Discussion and Comparison of ISDB and ITD Methodologies

This section provides a brief overview and comparison of the ISDB and ITD methodologies employed to estimate hazardous waste and constituent discharges to POTWs. More detailed descriptions of these methodologies appear in Appendix D. During the early phases of the study, the ISDB and ITD data bases were determined to be the best available sources of pollutant loadings data for the organics industry. When the ISDB data base was separately compared to ITD's organics and pesticide data bases, no data base was deemed superior to the other. Therefore, to ensure that the strengths of each source were fully incorporated in the analysis, and because of the substantial complexity and differences of the data sources, the ISDB and ITD data bases were not integrated to generate composite loadings.

TABLE 3-4. TYPES OF DATA CONTAINED IN ITD AND ISDB DATABASES

	ITD Data Bases (OCPSF and Pesticides)	ISDB Data Base
Data Contained in Data Base	• Loadings of Priority Hazardous Constituents • Treatment/Removal of Hazardous Wastes and Constituents	• Loadings of Priority Hazardous Constituents • Loadings of Nonpriority Hazardous Constituents • Loadings of RCRA Characteristic and Listed Wastes
Data Not Contained in Data Base	• Loadings of Nonpriority Hazardous Constituents • Loadings of RCRA Characteristic and Listed Wastes	• Treatment/Removal of Hazardous Wastes and Constituents

A comparison of results from the two separate analyses revealed some agreement on aggregate constituent loadings, but less agreement on constituent-specific loadings. For the four industrial categories considered (dye manufacture and formulation; organic chemicals; pesticide manufacturing; and plastics, resins, and synthetic fibers), the total raw priority hazardous constituent loadings were 31,442 kkg/yr based on the ISDB estimates, and 12,682 kkg/yr based on the ITD estimates. These results represent a 61 percent difference, a relatively minor divergence considering that estimates were generated using different sources and analytical methodologies. Constituent-specific comparisons, however, revealed more variable results, including the presence of numerous pollutants identified by only one of the two sources. These apparent discrepancies can be accounted for by closely examining the data sources and methodologies.

As described further in Appendix D, the most fundamental differences in the ISDB and ITD data lie in the purposes and objectives of the data bases and the programs they support, the data collection methods, and the analytical methodologies employed to produce estimates for this study. Developed for EPA/OSW, the ISDB is based on RCRA Section 3007 surveys of the organic chemical industry, which were aimed at identifying potential RCRA hazardous wastes from industry or product groups of concern. The surveys were not intended to be statistically representative of an industrial category or product group. The selection of industries or products of concern was based solely on OSW priorities and the availability or lack of information characterizing the wastes of concern.

The ITD data bases, developed for EPA/OW, are based on CWA Section 308 surveys of the organics industry to support the development of effluent guideline regulations. Although questionnaires were distributed to all known organics manufacturers, they did not require facilities producing organic chemicals at less than 50 percent of their total facility production to supply waste composition data. General information was requested from these facilities regarding products and process wastewater flows. The ISDB and ITD surveys did not define the organics industry using the same criteria, although every effort possible was made to account for this when extrapolating the facility data to National estimates.

Methodologies were developed to use these data sources to generate hazardous constituent loading estimates for each industrial category (see Appendix D). The ISDB methodology consisted essentially of estimating typical values for hazardous constituent concentrations and waste quantities not reported by the manufacturer and scaling up to National totals, based on the percentage of total National production accounted for by ISDB data for each industrial category. These scale-ups were not performed on a product or product group basis, but were applied within each industrial category. The ITD methodology extrapolated reported data to National estimates for similar processes. The ISDB methodology assumes that wastestreams and constituents included in the data base are representative of the remaining portions of the industry, while the ITD methodology assumes that similar processes will generate similar wastes. Obviously, neither of these assumptions will hold in every case; therefore, hazardous constituent-specific loadings may be underestimated or overestimated in some instances. Under either methodology, constituent loadings cannot be estimated for any hazardous constituent that is not reported in the data base. These omissions account for hazardous constituents that appear in only one data base.

Another methodological issue relates to the way in which hazardous constituent concentrations are reported in the ISDB. Approximately one-half of the concentration values are reported as ranges (i.e., 1 to 10 percent, 10 to 50 percent, etc.). In these instances, the mean of the range was used to calculate pollutant loadings.

ISDB data were collected over several years (1981 through 1983), while the ITD data represent manufacturing profiles for 1980 alone. Because 1981 and 1982 were depressed years economically for the organics industries, ITD pollutant loadings would be expected to be higher than ISDB loadings, except for the plastic and resin industry, which was surveyed by the ISDB in 1983, a relatively strong year for the plastics industry.(1) Appendix D provides more information on the status of the organics industry.

In summary, neither the ISDB nor ITD data bases were developed with the DSS as their primary end use. All information sources have strengths and limitations that apply to this study. As discussed above, discrepancies exist between the two estimates on a hazardous constituent-specific basis because of the unique characteristics of each data source and the analytical methodologies applied to both. However, estimated hazardous constituent loadings from the two data sources fall within reasonable intervals of agreement. The two estimates presented in this report should be considered acceptable ranges of values.

3.2.2 Presentation of Findings for the Four Organic Chemicals Industrial Categories

This section presents study findings for the four organic chemicals industrial categories. Initially, discharge characteristics, including number of indirect dischargers and POTW process flow, are presented for each category. The following sections provide estimates for loadings of priority and nonpriority hazardous constituents discharged by these categories. Estimates of rates of generation and discharge of characteristic and listed hazardous wastes also are presented and evaluated.

3.2.2.1 Discharge Characteristics of the Organic Chemicals Industrial Categories

Data on discharge characteristics for the organics industries were derived from ITD data bases supporting the effluent guidelines rulemakings for the organic chemicals, plastics and synthetic fibers, and the pesticide manufacturing categories. Table 3-5 provides a summary of discharge data for the four organic chemicals industrial categories addressed in Section 3.2. As indicated in Table 3-5, the organics industries encompass an estimated 1,096 facilities, of which 468, or 43 percent of the total, are indirect dischargers. Approximately one-half of all indirect dischargers are organic chemical manufacturers. An additional one-third of the indirect dischargers are plastics, resins, and synthetic fibers manufacturers.

The four organics categories discharge a total of 103 million gallons per day of process wastewater to POTWs. As expected, the organic chemicals manufacturing category, which discharges 66 mgd of process wastewater, accounts for the largest share of all process wastewater (64 percent). The

TABLE 3-5. DISCHARGE CHARACTERISTICS OF THE ORGANIC CHEMICALS INDUSTRIAL CATEGORIES

Organic Chemical Industry	Dye Manufacture and Formulation	Organic Chemicals	Plastics, Resins, and Synthetic Fibers	Pesticides Manufacturing	Totals
Number of Facilities*	58	537	382	119	1,096
Number of Indirect Dischargers	47	230	153	38	468
Number of Direct Dischargers	11	174	124	45	354
Number of Zero Dischargers	2	142	112	25	281
Total Indirect Process Flow (MGD)	11.34	65.99	21.21	4.30	102.84
Total Direct Process Flow (MGD)	11.69	183.37	160.99	N/A	N/A

N/A: Not Available

*2 Dye, 7 Plastic, and 9 Organic facilities have both direct and indirect discharges and are counted twice. Further, 11 Pesticide Manufacturing facilities do not generate wastewaters.

plastics, dyes, and pesticide categories contribute 21 mgd (20 percent of all wastewater), 11 mgd (11 percent) and 4 mgd (4 percent), respectively, of all process wastewater from the organics industries to POTWs. Of the three categories for which direct flow data were currently available, the dye manufacture and formulation industrial category discharges the greatest proportion (i.e., 49 percent) of its total process wastewater to POTWs.

3.2.2.2 Hazardous Constituent Loadings for the Four Organic Chemicals Industrial Categories

Appendix E presents estimates for hazardous constituent loadings for the four organic chemicals industrial categories. Appendix E presents loadings both for priority hazardous constituents (i.e., CWA priority pollutants) and nonpriority hazardous constituents. In addition, loadings estimates are provided for three different treatment levels, including raw discharge, current discharge (i.e., discharge at current treatment levels), and after PSES discharge (i.e., discharge at treatment levels required to meet proposed and promulgated PSES limitations). In projecting after PSES loadings for the dye manufacture and formulation; organic chemicals; and plastics, resins, and synthetic fibers categories, the analysis incorporates proposed PSES limitations developed for the ongoing effluent guidelines rulemaking for the OCPSF category. In estimating after PSES loadings for the pesticide manufacturing category, the analysis utilizes recently promulgated PSES limitations developed as part of the pesticides manufacturing rulemaking.

EPA/OW analyses conducted during the OCPSF and pesticide rulemaking did not evaluate treatment and removal rates for most nonpriority hazardous constituents. As a result, the amounts of nonpriority hazardous constituents discharged following PSES implementation were determined by applying the removal rates presented in Chapter 4. No industry in-plant controls were assumed.

Table 3-6 presents a summary of hazardous constituents for the four organic chemicals industrial categories. Hazardous constituent loadings to POTWs are segregated by metals (i.e., for this study, cyanide is included as a metal), priority organics, and nonpriority organics. This format allows

TABLE 3-6. SUMMARY OF HAZARDOUS CONSTITUENT LOADINGS TO POTWs FOR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES

ISDB - Priority and Nonpriority Constituents	Total Hazardous Metals[1] (kkg/yr)			Total Hazardous Organics - Priority Constituents Only (kkg/yr)			Total Hazardous Organics - Nonpriority Constituents Only (kkg/yr)		
	Raw	Current	PSES	Raw	Current	PSES	Raw	Current	PSES
Dye Manufacture and Formulation	431	429	<1	434	434	<1	11,400	11,400	136
Organic Chemicals Manufacturing	5,982	5,531	552	15,931	15,166	846	13,918	13,302	996
Plastics, Resins, and Synthetic Fibers Manufacturing	120	120	9	8,514	8,115	10	10,188	5,916	865
Pesticides Manufacture	232	116	2	536	267	<1	28,055	14,027	533
TOTALS	6,765	6,196	563	25,415	24,982	856	63,561	44,645	2,530
ITD Data Bases - Priority Constituents Only									
Dye Manufacture and Formulation	279	278	<1	206	206	<1	N/A	N/A	N/A
Organic Chemicals Manufacturing	1,022	961	5	6,067	5,824	6	N/A	N/A	N/A
Plastics, Resins, and Synthetic Fibers Manufacturing	53	52	2	2,200	2,106	1	N/A	N/A	N/A
Pesticides Manufacture	3	1	<1	2,852	1,426	<1	N/A	N/A	N/A
TOTALS	1,357	1,292	8	11,325	9,562	8	N/A	N/A	N/A

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[1] Includes cyanide

N/A - Not Available

effective comparison of metals and priority organics loadings based on ITD and ISDB data bases. Since the ITD data base does not contain data on nonpriority RCRA organics, nonpriority organic loadings are derived solely from ISDB data sources.

According to ISDB estimates, under raw conditions the organics industries discharge 6,765 metric tons per year of hazardous metals and cyanide (6,027 metric tons priority metals and cyanide, 738 metric tons of nonpriority metals). Of this amount, organic chemicals manufacturing accounts for 5,982 metric tons per year, or 88 percent of the total quantity discharged. The ITD data base projects significantly smaller raw metals and cyanide loadings of 1,357 metric tons per year (priority metals and cyanide only), but also shows the relative importance of the organic chemicals manufacturing category, which is estimated to discharge approximately 75 percent of all hazardous metals. As indicated in Tables 3-7 and 3-8, both the ITD and ISDB data bases show substantial loadings of cyanide, chromium, lead, nickel, and selenium. Based on ITD treatment/removal analyses, Table 3-6 shows that PSES implementation should result in a 99 percent reduction in hazardous metal loadings to POTWs.

Both the ITD and ISDB data bases show substantial raw loadings of priority organic constituents to POTWs. The ISDB data source projects a total raw loading of 25,415 metric tons per year of priority organic constituents. Of this total, 15,931 metric tons, or 63 percent, are attributed to organic chemicals manufacturing, while an additional 8,514 metric tons, or 34 percent, are attributed to plastic, resins, and synthetic fibers manufacturing. According to ISDB estimates, both dye manufacture and formulation and pesticide manufacturing are less significant sources of priority organic constituents. The ITD data bases show a total raw loading for priority organics of 11,325 metric tons per year. The ITD data base also demonstrates the relative importance of the organic chemicals manufacturing category (54 percent of all loadings) and the pesticides manufacturing category (25 percent).

Based on treatment data contained in the ITD data bases, Table 3-6 shows minimal constituent reductions at current treatment levels. For the PSES

TABLE 3-7. TOP 20 HAZARDOUS CONSTITUENTS WITH THE HIGHEST RAW, CURRENT, AND PSES LOADING FOR FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES - ITD DATA ONLY

Hazardous Constituent	Raw (kkg/yr)
Phenol	4,504
Benzene	1,536
4-Nitrophenol	1,191
Toluene	1,126
Cyanide	847
Acrolein	783
2,4-Dimethyl Phenol	648
Chlorobenzene	613
Lead and Compounds	242
Chromium and Compounds	198
Acrylonitrile	173
Ethyl Benzene	123
1,2-Dichloropropane	104
1,1,2-Trichloroethane	80
Methylene Chloride	61
Nitrobenzene	55
Selenium and Compounds	36
Naphthalene	34
Nickel and Compounds	32
Carbon Tetrachloride	23

Hazardous Constituent	Current (kkg/yr)
Phenol	4,367
4-Nitrophenol	1,189
Benzene	848
Cyanide	805
Acrolein	746
Toluene	745
2,4-Dimethyl Phenol	555
Chlorobenzene	307
Lead and Compounds	229
Chromium and Compounds	183
Acrylonitrile	163
Ethyl Benzene	119
1,2-Dichloropropane	94
1,1,2-Trichloroethane	72
Nitrobenzene	50
Selenium and Compounds	33
Naphthalene	33
Methylene Chloride	33
Nickel	32
Carbon Tetrachloride	19

Hazardous Constituent	PSES (kkg/yr)
Chromium and Compounds	1.756
Nickel and Compounds	1.109
Antimony	1.054
Selenium and Compounds	0.857
Toluene	0.841
Lead	0.627
Bis(2-Ethyl Hexyl) phthalate	0.549
Cadmium	0.491
Phenol	0.424
Benzene	0.405
Silver	0.398
Ethyl Benzene	0.266
Naphthalene	0.237
Methylene Chloride	0.231
Arsenic	0.207
Cyanide	0.187
Vinyl Chloride	0.147
Acrylonitrile	0.129
Dimethyl Phthalate	0.107
2,4-Dimethylphenol	0.72

TABLE 3-8. TOP 20 HAZARDOUS CONSTITUENTS WITH THE HIGHEST RAW, CURRENT, AND PSES LOADING FOR FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES - ISDB DATA ONLY

Hazardous Constituent	Raw (kkg/yr)
Methanol	18,069
Xylene	13,767
Phenol*	10,136
Formaldehyde	9,958
Acetone	7,137
Furfural	4,219
Aniline	2,649
Toluene*	1,873
Tetrahydrofuran	1,820
Methyl Isobutyl Ketone	1,724
Acrylonitrile*	1,586
Formic Acid	1,515
Benzene*	1,345
Lead and Compounds*	1,149
Chromium and Compounds*	1,094
Ethyl Benzene*	1,032
Nickel and Compounds*	842
Chloroform*	828
Cyanide*	745
Selenium*	730

*Priority Pollutants

Hazardous Constituent	Current (kkg/yr)
Methanol	14,387
Phenol*	9,810
Xylene	6,898
Formaldehyde	5,696
Furfural	4,032
Acetone	3,773
Aniline	2,636
Tetrahydrofuran	1,739
Methyl Isobutyl Ketone	1,648
Toluene*	1,609
Acrylonitrile*	1,489
Formic Acid	1,448
Benzene*	1,301
Lead and Compounds*	1,049
Ethylene Benzene*	994
Chromium and Compounds*	948
Chloroform*	783
Nickel and Compounds*	748
Cyanide*	710
Naphthalene*	709

*Priority Pollutants

Hazardous Constituent	PSES (kkg/yr)
Formaldehyde	854
Butyl Benzyl Phthalate*	609
Furfural	403
Xylene	345
Silver and Compounds*	302
Acetone	189
Methyl Isobutyl Ketone	165
Formic Acid	145
Aniline	132
Cyclohexanone	87
Tetrahydrofuran	87
Nickel and Compounds*	87
Arsenic and Compounds*	86
2,4-Dinitrophenol*	68
Anthracene*	56
Chromium and Compounds*	32
Tetrachloroethylene*	31
Chloroform*	25
Selenium and Compounds*	15
Chlorophenols	14

*Priority Pollutants

scenario, current ITD data project removal rates of greater than 99 percent for the priority organic constituents. These substantial removal rates are reflected in the reductions from raw and current discharge levels to PSES levels for the three OCPSF segments and the pesticide manufacturing category.

The two data bases show some agreement on specific priority organic constituents discharged by the organics industries. For example, all 5 of the priority organics that appear in Table 3-8 among the top 20 constituents under the raw and current discharge scenarios on the ISDB list (i.e., phenol, toluene, acrylonitrile, benzene, and ethyl benzene) also are included among the top 20 constituents on the ITD list (Table 3-7). Based on ITD data, other significant priority organics include chlorobenzene, 4-nitrophenol, 2,4-dimethylphenol, acrolein, methylene chloride, 1,2-dichloropropane, 1,1,2-trichloroethane, naphthalene, and nitrobenzene.

Table 3-6 also projects loadings of nonpriority organic constituents. The table shows a total raw loading of 63,561 metric tons per year of nonpriority organic constituents, and substantial loadings from each of the four organics industries. These loadings, as well as projected current and PSES loadings, demonstrate that the organics industries discharge substantial quantities of RCRA hazardous constituents that presently are not regulated under the CWA priority pollutant list. However, substantial incidental removal of these pollutants occurs assuming implementation of fully acclimated biological treatment systems. As indicated in Figure 3-1 and according to ISDB data, the organics industries discharge raw wastewaters containing 2.5 kilograms of nonpriority organic constituents for each kilogram of priority organic constituents. Although similar results can be anticipated for the current and after PSES discharge scenarios, these ratios are not presented here due to the uncertainty about incidental removal rates for nonpriority pollutants at current and PSES treatment levels. Table 3-8 contains lists of the top 20 ISDB constituents for raw, current, and after PSES scenarios. Major nonpriority constituents on these lists include methanol, xylene, formaldehyde, acetone, furfural, aniline, tetrahydrofuran, methyl isobutyl ketone, formic acid, and cyclohexanone. Also, analysis of ISDB results reveals the presence in organics industry wastewaters of numerous other

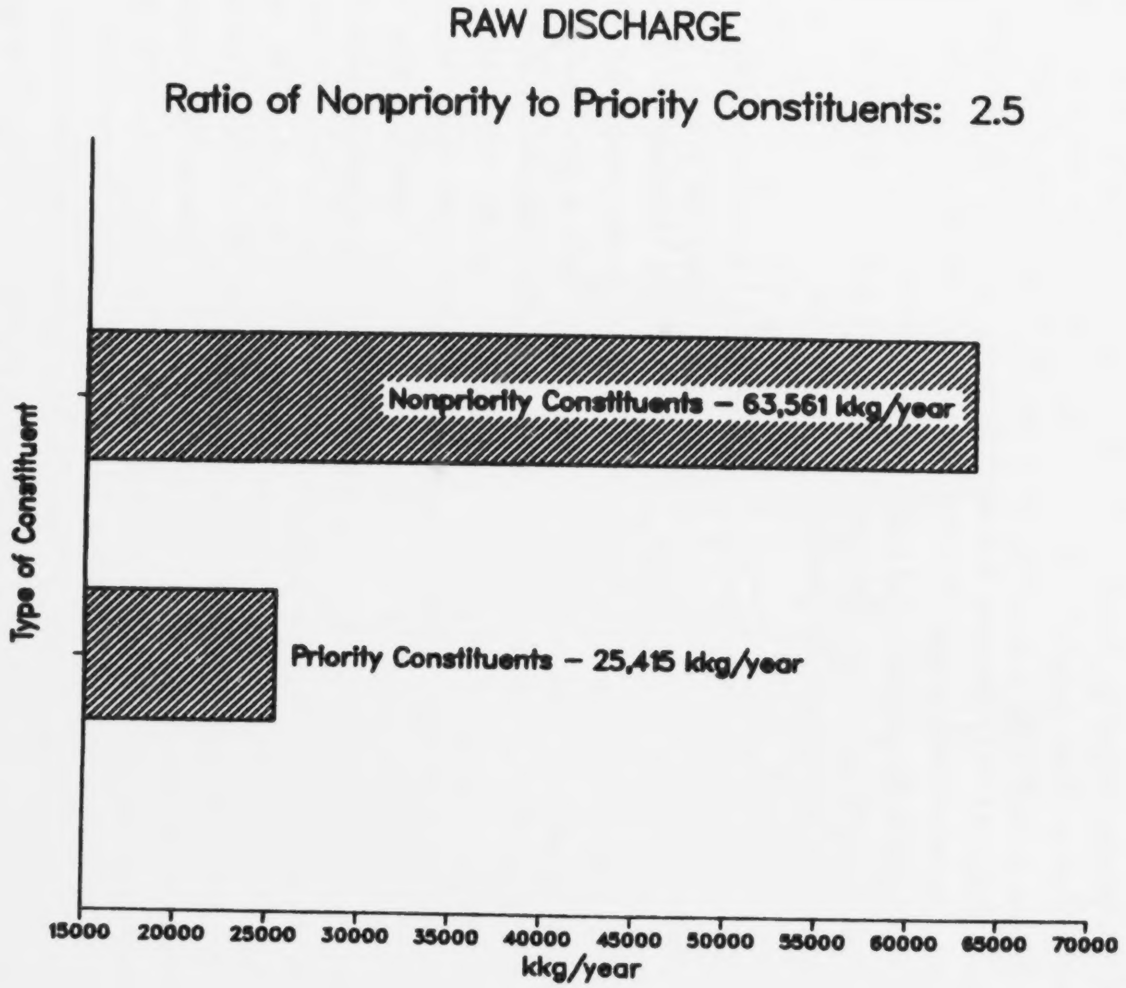

FIGURE 3-1. COMPARISON OF LOADINGS OF NONPRIORITY TO PRIORITY ORGANIC CONSTITUENTS FOR THE FOUR ORGANICS CHEMICALS INDUSTRIES

organic and inorganic compounds that are not included in existing RCRA or CWA pollutant lists.

The pesticides group of hazardous organics has been a major concern over the past several years. Appendix E presents the loadings of those hazardous constituents utilized in the pesticides manufacturing process, as estimated by both ITD and ISDB methodologies. Loadings to POTWs of specific active ingredients discharged by pesticide manufacturing facilities have been estimated by ITD to support the recent pesticides rulemaking efforts. The following summarizes these estimated loadings to POTWs:

Pesticide Hazardous Constituent Groups	Current Loading (kg/year)	After PSES Loading (kg/year)
2,4-D, 2-4-DB, Alachlor Atrazine, Dichlorvos, Mevinphos Parathion Ethyl, Parathion Methyl	121,813	1,858
Busan 40, Busan 05, Carbam-S, KN Methyl, Mancozeb, Maneb, Metham, ZAC, Zineb	6,295	68

Table 3-9 provides a summary of the loadings of volatile and ignitable/reactive hazardous constituents to POTWs. The hazardous constituents represented in the table include 59 volatile and 49 ignitable/reactive constituents identified from a review of the DSS constituent list of 165 constituents. This analysis examined physical and chemical properties (i.e., flashpoint, Henry's constant) of the hazardous constituents to determine ignitability and potential for volatilization. Because many of these compounds are discharged at low concentrations or are only marginally volatile, discharge of the constituent does not necessarily imply a concomitant effect, such as volatilization or explosion. Still, the analysis does indicate that substantial quantities of volatile and ignitable/reactive constituents are discharged to POTWs. According to ISDB data sources, approximately 63 percent of all hazardous constituents discharged in raw wastes are ignitable/reactive, while 68 percent of these constituents are potentially volatile. According to ITD data bases, 30 percent of priority hazardous constituents in raw wastes are ignitable/reactive, while 22 percent of these constituents are potentially

TABLE 3-9. LOADINGS OF VOLATILE AND IGNITABLE/REACTIVE CONSTITUENTS FROM THE FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES

	Total Volatile Constituents (kkg/yr)			Total Ignitable/ Reactive Constituents (kkg/yr)		
	Raw	Current	After PSES	Raw	Current	After PSES
ISDB - Priority and Nonpriority Constituents						
Dyes and Pigments	8,769	8,769	3	11,111	11,111	121
Organic Chemicals Manufacturing	16,290	15,572	751	16,883	16,165	812
Plastics, Resins, and Synthetic Fibers	10,931	6,543	866	10,937	6,546	866
Pesticides Manufacturing	28,080	28,080	1,036	21,423	21,423	703
TOTALS	64,700	58,964	2,656	60,354	55,245	2,502
ITD Data Base - Priority Constituents Only						
Dyes and Pigments	2	2	<1	2	2	<1
Organic Chemicals Manufacturing	1,649	1,576	2	2,379	2,276	2
Plastics, Resins, and Synthetic Fibers	110	91	1	110	92	<1
Pesticides Manufacturing	1,085	1,085	<1	1,360	1,360	<1
TOTALS	2,846	2,754	5	3,851	3,730	5

volatile. These loadings indicate that volatilization may be a significant concern for discharges originating from the organics industries.

Because the ISDB has been developed by EPA/OSW primarily to assist the Agency in identifying and listing (as hazardous wastes) specific process wastes from the organic chemicals industries, data contained in ISDB provide estimates of quantities of concentrated hazardous waste at the point of production at industrial facilities. Accordingly, estimates derived from ISDB do not consider the effects of dilution/mixing, volume reduction, or treatment (e.g., neutralization, biological treatment, chemical precipitation, etc.) on quantities of hazardous waste ultimately treated, stored, or disposed pursuant to RCRA requirements. For this reason, estimates presented in this study cannot be compared with other Agency hazardous waste estimates that consider the effects of dilution or treatment.

3.2.2.3 RCRA Hazardous Waste Discharges to POTWs from the Four Organic Chemicals Industrial Categories

As part of the Hazardous Waste Identification and Listing Program, EPA/OSW has collected and compiled extensive information on the generation and disposal of hazardous wastes by the organic chemicals industries in the ISDB. This data base was used to estimate types and quantities of both characteristic and listed hazardous waste discharged to POTWs by the four organic chemicals industrial categories. EPA/OSW also has begun an effort to collect hazardous waste data for the petroleum refining industry. While nonconfidential RCRA 3007 questionnaires provided some useful data on hazardous waste disposal practices, most of the petroleum refining data have not been organized and computerized yet to allow effective comparison with the other four organics categories.

Table 3-10 provides a detailed summary of hazardous waste data for the four organics industries. The table disaggregates RCRA data by waste type, industrial category, and disposal method. In some instances, related waste types have been grouped together to mask confidential business information. For example, three characteristic wastes from the pesticides industry have been added together and designated "DXXX." This grouping technique prevents

TABLE 3-10. PROFILE OF ULTIMATE DISPOSAL METHODS FOR CONCENTRATED HAZARDOUS WASTES GENERATED BY FOUR ORGANIC CHEMICALS INDUSTRIES (1,2)

RCRA WASTE	INDUSTRIES	NUMBER OF ISDB WASTES	EXTRAPOLATED TOTAL WASTE QUANTITY (METRIC TONS/YR)	EXTRAPOLATED QUANTITY OF WASTES				
				TO POTW	TO NPDES	TO INJ. WELL	TO PRI OTW	OTHER
DXXX	Organic Chemicals	2	2,278.55	--	--	--	--	2,278.55
	Pesticides	3	1,110.78	--	--	--	--	1,110.78
	Plastics & Resins	4	2,414.08	--	--	2,212.32	--	301.76
Subtotal		9	5,803.41	0.00	0.00	2,212.32	0.00	3,691.09
D001	Dyes and Pigments	14	5,035.95	1,251.78	--	--	--	3,784.17
	Organic Chemicals	197	5,039,631.00	4,559.09	1,872,873.00	17,589.61	--	3,144,610.00
	Pesticides	70	150,461.60	1,493.91	19.80	900.90	1,944.36	146,102.60
	Plastics & Resins	125	655,817.10	2,106.80	341,802.10	29.44	4,541.12	307,337.70
Subtotal		406	5,850,945.65	9,411.58	2,214,694.90	18,519.95	6,485.48	3,601,834.47
D002	Dyes and Pigments	20	783,794.70	144,693.10	636,107.00	846.30	--	2,148.30
	Organic Chemicals	347	31,946,941.00	29,866.55	11,599,430.00	12,258,480.00	54,910.07	8,004,254.00
	Pesticides	75	1,960,982.00	451,795.40	1,077,551.00	383,394.30	900.90	47,340.81
	Plastics & Resins	39	2,125,247.00	6,830.08	1,765,196.00	--	1,181.28	352,039.80
Subtotal		481	36,816,964.70	633,185.13	15,078,284.00	12,642,720.60	56,992.25	8,405,782.91
D003	Organic Chemicals	6	25,609.67	--	--	54.09	--	25,555.58
	Plastics & Resins	6	1,874.63	--	--	1.51	--	1,873.12
Subtotal		12	27,484.30	0.00	0.00	55.60	0.00	27,428.70
EP Toxic	Organic Chemicals	30	13,462,857.00	0.30	13,388,432.00	3,417.82	--	71,006.22
	Pesticides	8	5,738.30	--	--	--	--	5,738.30
	Plastics & Resins	2	0.18	0.18	--	--	--	--
Subtotal		40	13,468,595.48	0.48	13,388,432.00	3,417.82	0.00	76,744.52
Extremely Hazardous	Organic Chemicals	4	2,674.56	--	--	--	--	2,674.56
Subtotal		4	2,674.56	--	--	--	--	2,674.56
F002	Pesticides	3	1,323.63	--	--	--	--	1,323.63
	Plastics & Resins	1	51.52	--	--	--	--	51.52
Subtotal		4	1,375.15	0.00	0.00	0.00	0.00	1,375.15
F003	Pesticides	2	24,003.54	23,843.16	--	--	--	160.38
	Plastics & Resins	2	11.04	--	--	--	--	11.04
Subtotal		4	24,014.58	23,843.16	0.00	0.00	0.00	171.42
F004	Organic Chemicals	1	451.73	--	--	--	--	451.73
	Plastics & Resins	1	3,477.60	--	--	--	--	3,477.60
Subtotal		2	3,929.33	0.00	0.00	0.00	0.00	3,929.33

TABLE 3-10. PROFILE OF ULTIMATE DISPOSAL METHODS FOR CONCENTRATED HAZARDOUS WASTES GENERATED BY FOUR ORGANIC CHEMICALS INDUSTRIES (1,2) (Continued)

				EXTRAPOLATED QUANTITY OF WASTES				
RCRA WASTE	INDUSTRIES	NUMBER OF ISDB WASTES	EXTRAPOLATED TOTAL WASTE QUANTITY (METRIC TONS/YR)	TO POTW	TO NPDES	TO INJ. WELL	TO PRI OTW	OTHER
F005	Pesticides	2	1,291.95	--	--	--	--	1,291.95
	Plastics & Resins	6	54,316.80	--	--	--	--	54,316.80
Subtotal		8	55,608.75	0.00	0.00	0.00	0.00	55,608.75
KXXX	Organic Chemicals	112	1,045,131.00	1,610.90	63,922.78	579,842.20	--	399,755.20
	Pesticides	31	95,153.85	29,641.59	20,660.31	25,201.44	--	19,650.51
	Plastics & Resins	1	1,586.08	--	--	--	--	1,586.08
Subtotal		144	1,141,870.93	31,252.49	84,583.09	605,043.64	0.00	420,991.79
PXXX	Organic Chemicals	4	1,231.71	--	--	--	--	1,231.71
Subtotal		4	1,231.71	0.00	0.00	0.00	0.00	1,231.71
Toxic	Dyes and Pigments	3	3,194.55	1,064.85	--	--	--	2,129.70
	Organic Chemicals	153	4,252,467.00	1,143.26	240,038.80	323,531.20	--	3,687,754.00
	Pesticides	70	360,763.10	21,768.12	145,067.70	1,750.32	0.89	192,176.10
	Plastics & Resins	42	446,830.50	--	11,341.76	390,013.80	--	45,475.03
Subtotal		268	5,063,255.15	23,976.23	396,448.26	715,295.32	0.89	3,927,534.83
UXXX	Organic Chemicals	8	8,923.16	--	3,958.11	--	--	4,965.05
	Plastics & Resins	2	25.76	--	--	--	--	25.76
Subtotal		10	8,948.92	0.00	3,958.11	0.00	0.00	4,990.81
TOTAL		1,396	62,472,702.62	721,669.07	31,166,400.36	13,987,265.25	63,478.62	16,533,990.04

[1] This table provides a profile of the ultimate disposal methods for concentrated hazardous wastes as measured at the point of industrial production, and does not consider the effects of dilution/mixing, volume reduction, or treatment on waste quantities ultimately treated, stored, or disposed pursuant to RCRA requirements. Accordingly, these estimates cannot be compared with other Agency hazardous waste estimates that consider the effects of dilution and treatment.

[2] Some double counting may occur between management practices.

KEY TO TABLE 3-10. WASTE TYPES AS DEFINED BY RCRA §261.21-.33

DXXX	Generic listing for solid wastes exhibiting the characteristic of EP Toxicity (pesticides and EP metals).
D001	A solid waste exhibiting the characteristic of ignitability.
D002	A solid waste exhibiting the characteristic of corrosivity.
D003	A solid waste exhibiting the characteristic of reactivity.
EP Toxic	A solid waste exhibiting the characteristic of EP Toxicity.
Extremely Hazardous	An acute hazardous waste, as defined in §261.33.
F002	A listing of hazardous wastes from nonspecific sources, which includes the following spent halogenated solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichloro-fluoromethane; and the still bottoms from the recovery of these solvents.
F003	A listing of hazardous wastes from nonspecific sources, which includes the following spent nonhalogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, methanol; and the still bottoms from the recovery of these solvent.
F004	A listing of hazardous wastes from nonspecific sources, which includes the following spent nonhalogenated solvents: cresols and cresylic acid, nitrobenzene; and the still bottoms from the recovery of these solvents.
F005	A listing of hazardous wastes from nonspecific sources, which includes the following spent nonhalogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine; and the still bottoms from the recovery of these solvents.
KXXX	A generic listing for hazardous wastes from specific sources.
PXXX	A generic listing for discarded commercial chemical products, off-specification species, container residues, and spill residues thereof that are identified as acute hazardous wastes.
TOXIC	Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof that are identified as toxic hazardous wastes.
UXXX	A generic listing for toxic hazardous wastes.

possible identification of individual facility data associated with specific hazardous waste codes. A key to the different waste codes follows the table.

Table 3-11 provides a summary of hazardous waste generation and discharge data for the four organics industries and the petroleum refining industry. As discussed previously, nonconfidential RCRA 3007 questionnaires were used to estimate waste generation and discharge rates for the petroleum refining industry. As indicated in Table 3-11, these five categories together generate over 64 million metric tons of hazardous waste per year. Organic chemicals manufacturing alone accounts for approximately 55 million metric tons per year, or approximately 87 percent of all hazardous waste generated. The remaining four categories each generate substantially smaller quantities of hazardous waste.

As demonstrated in Figure 3-2, POTW disposal accounts for only a small portion of all hazardous waste disposal, largely due to the current disposal practices of the organic chemicals industries. Of the 62 million metric tons of hazardous waste generated each year, only 720 thousand metric tons, or 1.2 percent of the total quantity, are discharged to POTWs. Alternatively, approximately 50 percent of all hazardous waste is discharged to surface waters under NPDES permits, 22 percent is disposed in underground injection wells, while remaining wastes are incinerated, recovered, discharged to privately owned treatment works, or disposed at land disposal facilities.

Figure 3-3 provides a source profile for hazardous wastes discharged by the four organic chemicals industrial categories. As indicated in Figure 3-3, most hazardous wastes discharged to POTWs originate from the pesticides manufacturing and dye manufacture and formulation categories, which account for 73 and 20 percent, respectively. The pesticides and dye industries discharge 20 and 19 percent, respectively, of their industry wastes to POTWs. On the other hand, the organic chemicals industry, which generates the largest quantity of hazardous wastes, discharges only one-tenth of 1 percent of its

TABLE 3-11. SUMMARY OF HAZARDOUS WASTE GENERATION AND DISCHARGE RATES FOR FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES AND PETROLEUM REFINING CATEGORY[1]

Industry	Total RCRA Waste Generated (MT/yr)	Total RCRA Waste to POTWs (MT/yr)	Percent Of Total Waste Discharged to POTWs (%)	Percent of Waste Discharged to POTWs (per industry)
Dye Mfg. and Formulation	792,025	147,010	19.5	18.6
Organic Chemicals	55,788,196	37,180	4.9	0.1
Pesticides	2,600,829	528,542	70.1	20.3
Petroleum Refining*	2,002,645	32,458	4.3	1.6
Plastics and Resins	3,291,654	8,937	1.2	0.3
TOTALS	64,475,348	754,127	100%	1.2%

*Does not include hazardous wastes generated from Coal, Oil, and Petroleum Products portion of this subcategory. Data presented were extrapolated from 71 nonconfidential RCRA 3007 questionnaires to the total industry response (171 facilities).

[1] This table provides a profile of the ultimate disposal methods for concentrated hazardous wastes as measured at the point of industrial production, and does not consider the effects of dilution/mixing, volume reduction, or treatment on waste quantities ultimately treated, stored, or disposed pursuant to RCRA requirements. Accordingly, these estimates cannot be compared with other Agency hazardous waste estimates that consider the effects of dilution and treatment.

PROFILE OF ULTIMATE DISPOSAL METHODS FOR CONCENTRATED HAZARDOUS WASTE GENERATED BY FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES[1]

Total Hazardous Waste: 62,472,702 kkg/year

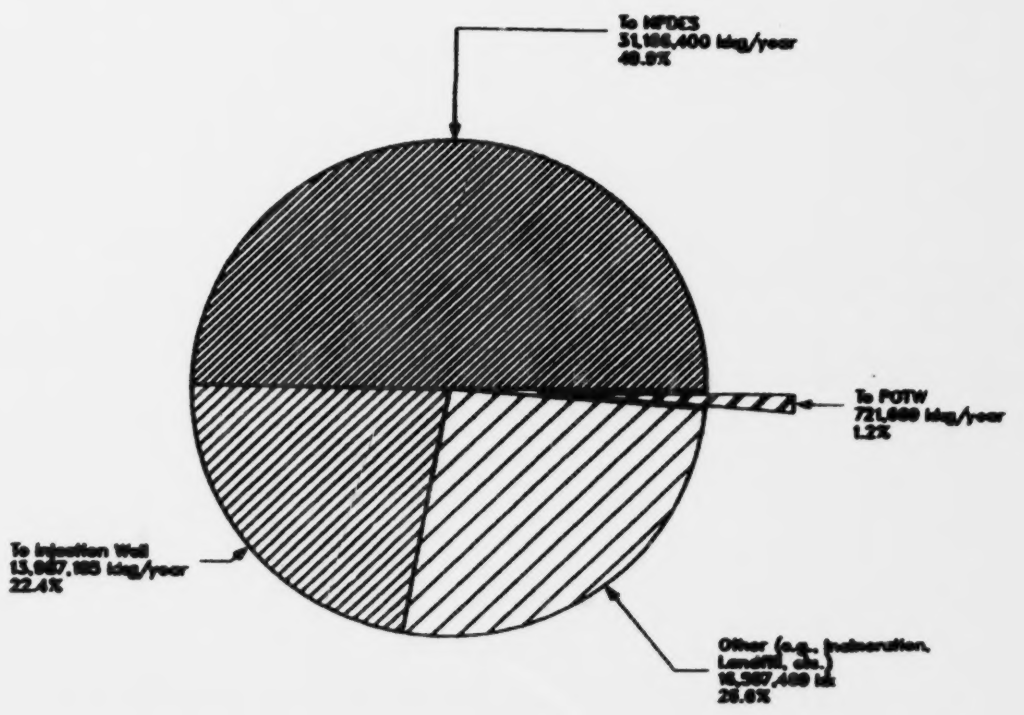

FIGURE 3-2.

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[1] This figure provides a profile of the ultimate disposal methods for concentrated hazardous wastes as measured at the point of industrial production, and does not consider the effects of dilution/mixing, volume reduction or treatment on waste quantities ultimately treated, stored, or disposed of pursuant to RCRA requirements. Accordingly, these estimates cannot be compared with other Agency hazardous waste estimates which consider the effects of dilution and treatment.

SOURCE PROFILE FOR CONCENTRATED HAZARDOUS WASTES ULTIMATELY DISCHARGED BY FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES[1]

Total Hazardous Waste Discharged to POTWs: 721,669 kkg/year

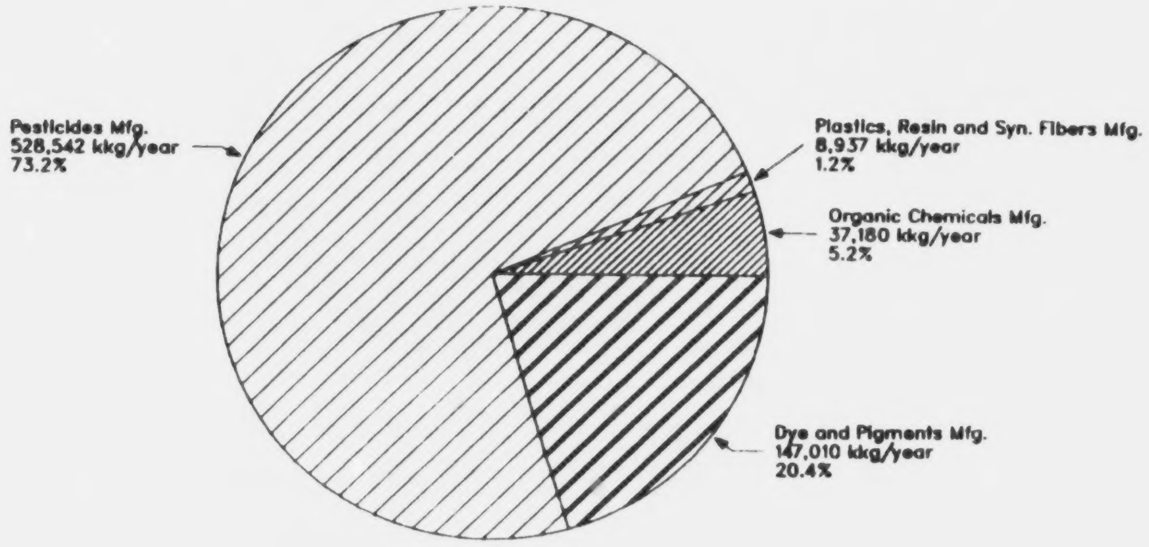

FIGURE 3-3

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[1] This figure provides a source profile for concentrated hazardous waste quantities as measured at the point of industrial production, and does not consider the effects of dilution/mixing, volume reduction or treatment on waste quantities discharged to POTWs. As indicated in the footnote to Figure 3.2, these quantities should not be interpreted as waste quantities treated, stored, or disposed of pursuant to RCRA requirements.

hazardous wastes to POTWs. Amendments to RCRA hazardous waste definitions could significantly change the source profile for hazardous wastes discharged to POTWs.

Figure 3-4 provides a profile of hazardous waste types discharged to POTWs by the four organics industries. Figure 3-4 demonstrates that 89 percent of hazardous waste discharged to POTWs represents characteristic waste. Corrosive wastes alone account for 88 percent of the total. The remaining 12 percent are listed wastes, including spent solvents (3.3 percent of all waste), K-code listed wastes (4.3 percent), and unspecified toxic wastes (3.3 percent). The ISDB does not always provide specific information on degree of treatment at these organics facilities. Still, in light of the prohibited discharge standard for corrosive waste (i.e., pH less than 5.0) and the significant use of equalization, neutralization, or more sophisticated treatment within these industry groups, it is likely that most of the characteristic waste receives some treatment prior to discharge to a POTW. Substantial changes in RCRA hazardous waste listings may correspondingly alter the distribution of waste types discharged to POTWs.

3.3 TYPES AND QUANTITIES OF HAZARDOUS WASTES AND CONSTITUENTS DISCHARGED BY SELECTED CONSENT DECREE INDUSTRIES

This section presents and evaluates the types and quantities of hazardous wastes and constituents discharged by selected consent decree industrial categories. Again, these industrial categories were selected from the list of industrial categories contained in the 1976 NRDC Consent Decree for which the EPA/OW was required to develop categorical standards. These selected consent decree industrial categories (including the four organic chemicals industrial categories discussed in Section 3.2) constitute the larger generators of hazardous wastes for which hazardous constituent data were available from ITD, either in terms of total quantity generated by the category as a whole or generated by individual facilities within an industrial category. These industry categories are:

PROFILE OF HAZARDOUS WASTE TYPES DISCHARGED TO POTWs

BY FOUR ORGANIC CHEMICALS INDUSTRIAL CATEGORIES[1]

Total Hazardous Waste Discharged to POTWs: 721,669 kkg/year

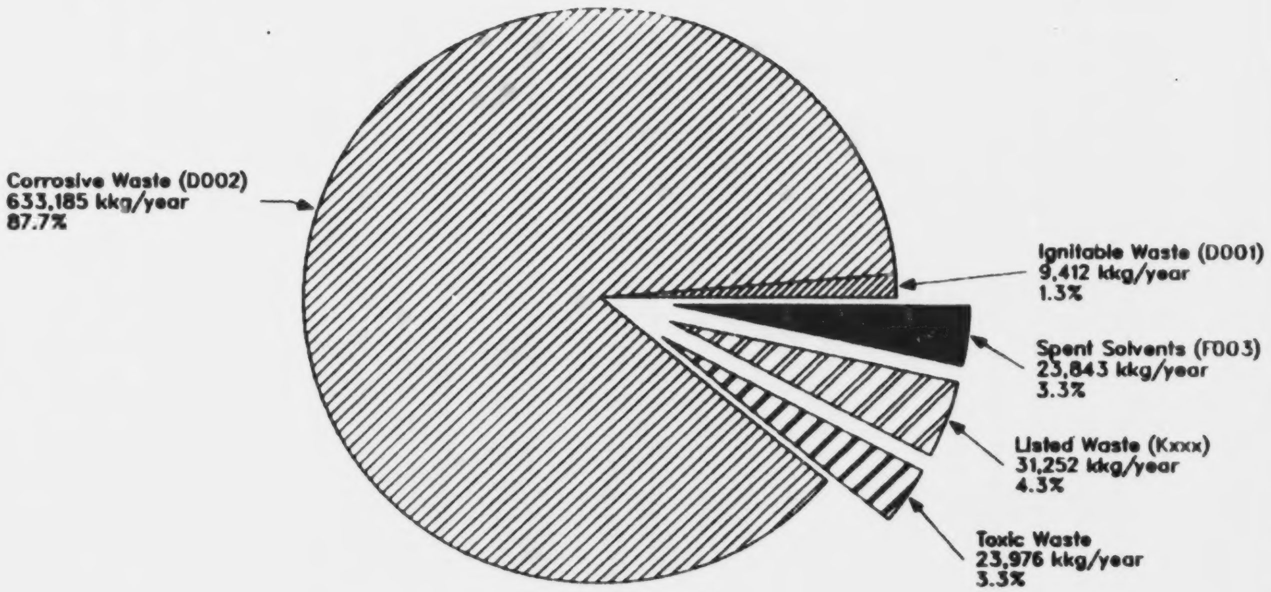

FIGURE 3-4

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[1] This figure provides a discharge profile for concentrated hazardous waste quantities as measured at the point of industrial production, and does not consider the effects of dilution/mixing, volume reduction or treatment on waste quantities discharged to POTWs. As indicated in the footnote to Figure 3.2, these quantities should not be interpreted as waste quantities treated, stored, or disposed of pursuant to RCRA requirements.

- Adhesives and Sealants
- Battery Manufacturing
- Coal, Oil, and Petroleum Products and Refining
- Dye Manufacturing and Formulation
- Electrical and Electronic Components
- Electroplating and Metal Finishing
- Equipment Manufacturing and Assembly
- Explosives Manufacturing
- Gum and Wood Chemicals and Related Oils
- Industrial and Commercial Laundries
- Ink Manufacturing and Formulation
- Inorganic Chemicals Manufacturing
- Iron and Steel Manufacturing and Forming
- Leather Tanning and Finishing
- Nonferrous Metals Forming
- Nonferrous Metals Manufacturing
- Organic Chemicals Manufacturing
- Paint Manufacturing and Formulation
- Pesticides Formulation
- Pesticides Manufacture
- Pharmaceuticals Manufacturing
- Photographic Chemicals and Film Manufacturing
- Plastics Molding and Forming
- Plastics, Resins, and Synthetic Fibers Manufacture
- Porcelain Enameling
- Printing and Publishing
- Pulp and Paper Mills
- Rubber Manufacturing and Processing
- Textile Mills
- Timber Products Processing.

3.3.1 Discharge Characteristics of Selected Consent Decree Industries

The discharge characteristics of the selected industrial categories discussed in this section are presented in Table 3-12. These characteristics are: number of direct, indirect, and zero discharge facilities; total number of facilities; and the total indirect discharge flow for each industrial category listed. The following five sources were used to develop the basic characteristics for each industrial category:

- DSS Industry Profile Forms
- OSW ISDB (for organic chemicals industrial categories only)

- EPA Summary of ITD Rulemaking Activities
- ITD Development Documents
- EPA Monitoring and Data Support Division (MDSD) Industry Status Sheets.

The first data source, DSS Industry Profile Forms, were developed for use during this study. The basic form, shown in Appendix F, was provided to ITD Project Officers for the industrial categories analyzed during this study. DSS Industry Profile Forms were completed by ITD for a majority of the selected consent decree industrial categories. The completed profile forms received were treated as the most up-to-date information for a given category. When DSS Industry Profile Forms were not available, then ITD Development Documents and the EPA Summary of ITD Rulemaking Activities were used to gather the basic characteristics for that industrial category. The basic characteristics shown in Table 3-12 represent the industrial category and subcategory(ies), as utilized by ITD. Therefore, the numbers may not be totally representative of the industry categories developed for this study and presented in Appendix C. For example, the data presented in Table 3-12 for the Pulp and Paper industrial category exclude the paper products subcategory included for this study.

Examination of Table 3-12 reveals that greater than 80 percent of the indirect dischargers are from two service-related industrial categories, industrial and commercial laundries and printing and publishing. The industrial and commercial laundries category also ranks third highest in total indirect discharge flow, preceded only by pulp and paper and electroplating/metal finishing. The printing and publishing category ranks first in number of zero dischargers (zero discharger refers to facilities, that may or may not be connected to a POTW, that generate a process wastewater that is not discharged) followed by timber products processing and paint manufacturing and formulation. Zero discharge industrial facilities still have potential to dispose hazardous wastes into a POTW via spills and process changes, if they are connected to a POTW. The number of zero dischargers shown in Table 3-12 for each industrial category does not differentiate between those industrial facilities connected or not connected to POTWs. In summary, based on the data

TABLE 3-12. DISCHARGE CHARACTERISTICS OF SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES (INCLUDING ORGANIC CHEMICALS INDUSTRIAL CATEGORIES)

Industrial Category	Total Number of Facilities	Number of Indirect Dischargers	Number of Direct Dischargers	Number of Zero Dischargers	Total Indirect Discharge Flow (MGD)
Adhesives and Sealants	503	298	9	196	2.7
Battery Manufacturing	254	149	21	84	7.9
Coal, Oil, Petroleum Products, and Refining	170	45	104	21	92.3
Dye Manufacturing and Formulation	58	47[b]	11[b]	2	11.3
Electrical and Electronic Components	379	270	86	23	33.5
Electroplating and Metal Finishing	13,502	10,561	2,941	0	575.7
Equipment Manufacturing and Assembly	N/A[a]	N/A	N/A	N/A	N/A
Explosives Manufacturing	170	4	24	142	<1
Gum and Wood Chemicals, and Related Oils	120	10	11	99	3.0
Industrial and Commercial Laundries	68,800	68,635	165	0	526
Ink Manufacturing and Formulation	460	223	237	0	<1
Inorganic Chemicals Manufacturing	193	31	147	15	18.5
Iron and Steel Manufacturing and Forming	1,020	162	733	125	430.7
Leather Tanning and Finishing	160	141	17	2	6.4
Nonferrous Metals Forming	741	228	131	382	36.0
Nonferrous Metals Manufacturing	448	123	112	213	N/A
Organic Chemicals Manufacturing	537	230[b]	174[b]	142	65.9
Paint Manufacture and Formulation	1,500	751	6	743	0.8
Pesticides Formulation	1,255	169	0	1,086	3.9
Pesticides Manufacturing	119	38	45	25	4.3
Pharmaceuticals Manufacturing	465	279	54	134	48.0
Photographic Chemicals and Film Manufacturing	142	N/A	N/A	30	1.6
Plastics Molding and Forming[e]	2,587	1,145	810	632	18.4
Plastics, Resins, and Synthetic Fibers Manufacturing	382	153[b]	124[b]	112	21.2
Porcelain Enameling	116	88	28	0	5.6
Printing and Publishing	56,337	38,679	84	17,564	46.4
Pulp and Paper Mills	674[c]	261	338	56	585
Rubber Manufacturing and Processing	1,576	512	1,064	0	128.2
Textile Mills	1,973[f]	974	215	235	339.2
Timber Products Processing	14,100	7,000	500	6,600	<1[d]

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[a] N/A - Not Available.

[b] 2 Dye, 7 Plastic, and 9 Organic facilities have both direct and indirect discharges and are counted twice.

[c] Includes 19 facilities for which status is unknown.

[d] Flow only for wood preserving subcategory.

[e] Some double-counting included. Numbers represent number of processes at plastic molding and forming plants.

[f] Wet processing mills.

presented in Table 3-12, it would appear that if any substantial quantities of hazardous wastes were generated by the service-related industrial categories, then based on numbers of indirect and zero discharge facilities, these facilities also would have the potential to discharge substantial amounts of hazardous wastes to POTWs.

3.3.2 Priority Hazardous Constituent Loadings for the Selected Consent Decree Industrial Categories

This section presents priority hazardous constituent loadings for each of the selected consent decree industrial categories, including the organic chemicals industrial categories.

3.3.2.1 Methodology for Development of Hazardous Constituent Loadings for the Selected Consent Decree Industries

This section briefly describes the general methodology utilized to develop priority hazardous constituent loadings for the selected consent decree industry categories (the methodologies for development of loadings for the organic chemicals industrial categories are described in Appendix D and will not be repeated in this section). The primary data sources for the hazardous constituent loadings were DSS Industry Profile Forms and ITD Development Documents for each industry category. DSS Industry Profile Forms submitted by ITD Project Officers were consulted first to obtain loadings. Some profile forms contained amended or updated data for an industrial category, which was not contained in Development Documents. In most cases, however, reference to Development Documents was made in the profile forms to obtain priority hazardous constituent loadings. For those industry categories for which ITD had not submitted DSS Industry Profile Forms, appropriate Development Documents were utilized.

Depending upon the way in which data were presented within a given Development Document, raw priority hazardous constituent loadings were derived primarily in one of three ways:

- Screening and verification data presented by facility were used to develop an average facility loading for the entire category or preferably by subcategory. This average facility loading then was multiplied by the number of indirect discharge facilities within the category or subcategory and summed to obtain a total category loading.

- Screening and verification data presenting average concentrations for the entire category or individual subcategories were multiplied by total category or subcategory process flow to obtain a total category loading (if data were available, frequency of occurrence was taken into account).
- Screening and verification data presenting average mass of constituents per unit of production for the entire category or individual subcategories were multiplied by the average production given for an entire category or subcategory to obtain a total category loading.

For those industrial categories that have been exempted from regulation by categorical standards (through Paragraph 8 exclusions), estimates of current loadings were performed to account for any treatment already in-place by an industrial category. However, this estimate only was performed when necessary data were available in ITD Development Documents. Where the information was not available, a determination of current loadings was not performed, and raw loadings were assumed to be equal to current loadings. Further, for those exempt industrial categories, after PSES loadings also were assumed to be equal to current loadings.

For those industrial categories where categorical pretreatment standards are proposed or promulgated, an estimate of the reduction of hazardous priority pollutant loadings as a result of implementation of the standards was derived. Either these estimates of pollutant reductions were given in appropriate Development Documents, or they were derived by back-calculating loadings from the numerical standards for only the regulated pollutants. Except for the organic chemicals industrial categories, where current loadings were available, the current loadings were assumed to be equivalent to the loadings after implementation of pretreatment standards for these regulated industrial categories. Although several categorical standards are proposed, it was assumed that all categorical standards were promulgated and all facilities are in compliance.

Several key points and assumptions regarding the development of these hazardous constituent loadings for the selected consent decree industrial categories are as follows:

- An average of 250 operating days per year was assumed for all industrial categories except iron and steel; and coal, oil, and petroleum products and refining, where 365 operating days per year were assumed.
- No incidental removal of other nonregulated constituents was assumed unless data were provided within ITD Development Documents. Some reductions of all constituents may have been calculated for a given category (i.e., leather tanning) if flow reduction was considered a part of the treatment technology to meet categorical standards and adequate information was provided.
- In calculating loadings after implemention of pretreatment standards, it was assumed that all facilities within a given industrial category were in full compliance and discharging at the allowable level for each regulated constituent.
- Loadings do not account for any removals from a given industrial facility to meet more stringent or comprehensive local pretreatment standards applied by the POTW to which they discharge. In addition, adjustments for local removal credits were not accounted for.

Appendix G presents the annual mass loadings of priority hazardous constituents for the selected consent decree industrial categories, including the organic chemicals industrial categories. As previously discussed in Section 3.2, data for the four organic chemicals industrial categories will be presented as eight separate and distinct industrial categories. Again, these categories comprise the following:

- Dye Manufacture and Formulation (ITD Data)
- Dye Manufacture and Formulation (ISDB Data)
- Organic Chemicals Manufacturing (ITD Data)
- Organic Chemicals Manufacturing (ISDB Data)
- Plastics, Resins, and Synthetic Fibers Manufacturing (ITD Data)
- Plastics, Resins, and Synthetic Fibers Manufacturing (ISDB Data)
- Pesticides Manufacture (ITD Data)
- Pesticides Manufacture (ISDB Data).

Table 3-13 summarizes the total hazardous constituent loadings (priority pollutant metals and priority pollutant organics only) under the raw, current, and after implementation of pretreatment standards (herein referred to as "after PSES") scenarios for each industrial category. Appendix G also provides data for several industrial categories for nonhazardous priority pollutant metals (i.e., copper and zinc), other hazardous metals (i.e., thallium and barium), other priority hazardous organics, and other nonpriority hazardous organics. These data were incorporated into Appendix G for a limited number of industrial categories, due primarily to the data sources available for each industrial category and the methodology utilized for the development of these loadings.

3.3.3 Analysis of Hazardous Constituent Loadings for the Selected Consent Decree Industrial Categories

Based on the data presented in Appendix G and summarized in Table 3-13, each industrial category was ranked according to hazardous constituent loadings. Tables 3-14 and 3-15 present the top 10 selected consent decree industrial categories (including the organic chemicals industrial categories) with the highest total hazardous constituent loadings for priority pollutant metals and organics, respectively, under the raw, current, and after PSES scenarios. Table 3-16 presents the top 10 selected consent decree industrial categories (including the organic chemicals industries) with the highest total priority hazardous constituent loadings, also under the raw, current, and after PSES scenarios. To avoid double-counting for the organic chemicals industrial categories that were analyzed during this study using both ITD and ISDB methodologies, the higher of the two loadings calculated are shown in the rankings in Tables 3-14 to 3-16, with the lower of the two loadings presented in parentheses.

The electroplating/metal finishing industrial category accounts for the highest raw hazardous metals loadings, followed by the organic chemicals manufacturing (ISDB) category. Three of the organic chemicals industrial categories [organic chemicals manufacturing (ISDB); dye manufacture and formulation (ISDB); and plastics, resins, and synthetic fibers (ISDB)] are present in the top 10 current hazardous metals loadings. This may be due in

TABLE 3-13. LOADINGS OF TOTAL PRIORITY HAZARDOUS METALS AND CYANIDE AND TOTAL PRIORITY HAZARDOUS ORGANICS FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1]

	TOTAL PRIORITY HAZARDOUS METALS AND CYANIDE (kkg/yr)			TOTAL PRIORITY HAZARDOUS ORGANICS (kkg/yr)		
INDUSTRIAL CATEGORY	RAW	CURRENT	AFTER PSES	RAW	CURRENT	AFTER PSES
Adhesives & Sealants	289	131	131	97	70	70
Battery Mfg.	1509	<1	<1	<1	<1	<1
Dyes Mfg. and Formulation (ITD)	279	278	<1	206	206	<1
Dyes Mfg. and Formulation (ISDB)	431	429	1	434	434	1
Electrical & Electronic Components	158	74	74	315	32	32
Electroplating & Metal Finishing	42339	1017	1017	3631	175	175
Equipment Mfg. & Assembly	N/A	N/A	N/A	7715	7715	7715
Explosive Mfg.	<1	<1	<1	<1	<1	<1
Gum & Wood Chemicals	2	2	2	51	51	51
Industrial & Comm. Laundries	595	502	502	984	984	984
Ink Mfg. & Formulation	3	3	3	<1	<1	<1
Inorganic Chemicals Mfg.	1053	103	103	0	0	0
Iron & Steel Mfg.	3920	97	97	2715	236	236
Leather Tanning & Finishing	5097	375	375	210	164	164
Nonferrous Metal Forming	203	2	2	N/A	N/A	N/A
Nonferrous Metal Mfg.	114	1	1	9	1	1
Organic Chemicals Mfg. (ITD)	1021	961	5	4627	4406	5
Organic Chemicals Mfg. (ISDB)	5981	5531	552	9068	8717	679
Paint Mfg. & Formulation	17	15	15	49	42	42
Pesticide Mfg. (ITD)	3	1	<1	2852	1426	<1

TABLE 3-13. LOADINGS OF TOTAL PRIORITY HAZARDOUS METALS AND CYANIDE AND TOTAL PRIORITY HAZARDOUS ORGANICS FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1] (Continued)

INDUSTRIAL CATEGORY	TOTAL PRIORITY HAZARDOUS METALS AND CYANIDE (kkg/yr)			TOTAL PRIORITY HAZARDOUS ORGANICS (kkg/yr)		
	RAW	CURRENT	AFTER PSES	RAW	CURRENT	AFTER PSES
Pesticide Mfg. (ISDB)	232	116	2	326	163	<1
Pesticides Formulation (ITD)	N/A	0	0	N/A	<1	0
Petroleum Refining	485	485	485	1686	1686	1686
Pharmaceutical Mfg.	4563	35	35	7369	7369	7369
Photo. Chemicals & Film Mfg.	184	66	66	5	4	4
Plastics Molding & Forming	9	9	9	19	19	19
Plastics, Resins & Syn. Fibers (ITD)	52	52	2	2168	2075	1
Plastics, Resins & Syn. Fibers (ISDB)	120	120	9	8498	8100	10
Porcelain Enameling	177	17	17	1	<1	<1
Printing & Publishing	155	145	145	17	16	16
Pulp & Paper Mills	100	100	100	806	749	749
Rubber Mfg.	3	3	3	15	15	15
Textile Mills	79	79	79	370	370	370
Timber Products	3	3	3	34	11	11

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[1] Unless otherwise specified, loadings estimates are derived from ITD data sources.

TABLE 3-14. TOP TEN INDUSTRIAL CATEGORIES WITH THE HIGHEST LOADINGS FOR TOTAL HAZARDOUS CONSTITUENTS (PRIORITY METALS AND CYANIDE)[1]

INDUSTRIAL CATEGORY	RAW LOADING (kkg/year)
Electroplating & Metal Finishing	42,339
Organic Chemicals Manufacturing - ISDB (ITD)	5,981 (1,021)
Leather Tanning & Finishing	5,097
Pharmaceutical Manufacturing	4,563
Iron & Steel Manufacturing	3,920
Battery Manufacturing	1,509
Inorganic Chemicals Manufacturing	1,053
Industrial & Commercial Laundries	595
Petroleum Refining	485
Dye Manufacturing and Formulation - ISDB (ITD)	431 (279)

INDUSTRIAL CATEGORY	CURRENT LOADING (kkg/year)
Organic Chemicals Manufacturing - ISDB (ITD)	5,531 (961)
Electroplating & Metal Finishing	1,017
Industrial & Commercial Laundries	502
Petroleum Refining	485
Dye Manufacturing and Formulation - ISDB (ITD)	429 (278)
Leather Tanning & Finishing	375
Printing & Publishing	145
Adhesives & Sealants	131
Plastics, Resins, & Synthetic Fibers - ISDB (ITD)	120 (52)
Inorganic Chemicals Manufacturing	103

INDUSTRIAL CATEGORY	AFTER PSES LOADING (kkg/year)
Electroplating & Metal Finishing	1,017
Organic Chemicals Manufacturing - ISDB (ITD)	552 (5)
Industrial & Commercial Laundries	502
Petroleum Refining	484
Leather Tanning & Finishing	375
Printing & Publishing	145
Adhesives & Sealants	131
Inorganic Chemicals Manufacturing	103
Pulp & Paper Mills	100
Iron & Steel Manufacturing	97

[1] Unless otherwise specified, loadings estimates are derived from ITD data sources.

TABLE 3-15. TOP TEN INDUSTRIAL CATEGORIES WITH THE HIGHEST LOADINGS FOR TOTAL HAZARDOUS CONSTITUENTS (PRIORITY ORGANICS)[1]

INDUSTRIAL CATEGORY	RAW LOADING (kkg/year)
Organic Chemicals Manufacturing - ISDB (ITD)	9,068 (4,627)
Plastics, Resins, & Synthetic Fibers - ISDB (ITD)	8,498 (2,168)
Equipment Manufacturing & Assembly	7,715
Pharmaceutical Manufacturing	7,368
Electroplating & Metal Finishing	3,631
Pesticides Manufacturing - ITD (ISDB)	2,852 (326)
Iron & Steel Manufacturing	2,715
Petroleum Refining	1,686
Industrial & Commercial Laundries	984
Pulp & Paper Mills	806

INDUSTRIAL CATEGORY	CURRENT LOADING (kkg/year)
Organic Chemicals Manufacturing - ISDB (ITD)	8,717 (4,406)
Plastics, Resins, & Synthetic Fibers - ISDB (ITD)	8,100 (2,075)
Equipment Manufacturing & Assembly	7,715
Pharmaceutical Manufacturing	7,369
Petroleum Refining	1,686
Pesticides Manufacturing - ITD (ISDB)	1,426 (163)
Industrial & Commercial Laundries	984
Pulp & Paper Mills	749
Dye Manufacturing and Formulation - ISDB (ITD)	434 (206)
Textile Mills	370

INDUSTRIAL CATEGORY	AFTER PSES LOADING (kkg/year)
Equipment Manufacturing & Assembly	7,715
Pharmaceutical Manufacturing	7,369
Petroleum Refining	1,686
Industrial & Commercial Laundries	984
Pulp & Paper Mills	749
Organic Chemicals Manufacturing - ISDB (ITD)	679 (5)
Textile Mills	370
Iron & Steel Manufacturing	236
Electroplating & Metal Finishing	175
Leather Tanning and Finishing	164

[1] Unless otherwise specified, loadings estimates are derived from ITD data sources.

TABLE 3-16. TOP TEN INDUSTRIAL CATEGORIES WITH THE HIGHEST LOADINGS FOR TOTAL HAZARDOUS CONSTITUENTS (ALL PRIORITY POLLUTANTS)[1]

INDUSTRIAL CATEGORY	RAW LOADING (kkg/year)
Electroplating & Metal Finishing	45,970
Organic Chemicals Manufacturing - ISDB (ITD)	15,049 (5,648)
Pharmaceutical Manufacturing	11,931
Plastics, Resins, & Synthetic Fibers - ISDB (ITD)	8,616 (2,221)
Equipment Manufacturing & Assembly	7,715
Iron & Steel Manufacturing	6,635
Leather Tanning & Finishing	5,307
Pesticides Manufacturing - ITD (ISDB)	2,855 (558)
Petroleum Refining	2,171
Industrial & Commercial Laundries	1,579

INDUSTRIAL CATEGORY	CURRENT LOADING (kkg/year)
Organic Chemicals Manufacturing - ISDB (ITD)	14,248 (5,367)
Plastics, Resins, & Synthetic Fibers - ISDB (ITD)	8,218 (2,127)
Equipment Manufacturing & Assembly	7,715
Pharmaceutical Manufacturing	7,404
Petroleum Refining	2,171
Industrial & Commercial Laundries	1,486
Pesticide Manufacturing - ITD (ISDB)	1,427 (279)
Electroplating & Metal Finishing	1,191
Dyes & Pigments - ISDB (ITD)	861 (484)
Pulp & Paper Mills	850

INDUSTRIAL CATEGORY	AFTER PSES LOADING (kkg/year)
Equipment Manufacturing & Assembly	7,715
Pharmaceutical Manufacturing	7,404
Petroleum Refining	2,171
Industrial & Commercial Laundries	1,486
Electroplating & Metal Finishing	1,191
Organic Chemicals Manufacturing - ISDB (ITD)	1,231 (10)
Pulp & Paper Mills	850
Leather Tanning & Finishing	539
Textile Mills	450
Iron and Steel Manufacturing	333

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[1] Unless otherwise specified, loadings estimates are derived from ITD data sources.

part to the methodologies utilized for estimating current loadings for the organic chemicals industrial categories compared to the other selected consent decree industrial categories. Briefly, current loadings for the organic chemicals industrial categories were estimated or actually calculated. On the other hand, current loadings for the other selected consent decree industrial categories were assumed to be equivalent to after PSES loadings either because no PSES have been proposed or promulgated or because it was assumed that PSES compliance dates already have passed for categories regulated by PSES. The electroplating/metal finishing industrial category also accounts for the highest loading of hazardous metals after compliance with PSES. Under both the current and after PSES scenarios, three industrial categories in the top 10 with the highest priority hazardous metals loadings are those that have been exempted from regulation by categorical standards through the Paragraph 8 Exclusion in the 1976 NRDC Consent Decree with EPA (i.e., industrial and commercial laundries, adhesives and sealants, and printing and publishing).

The organic chemicals industrial categories dominate the top 10 rankings for the raw and current loadings for priority hazardous organics. Based upon proposed categorical standards, however, the hazardous organics loadings (priority only) drop significantly for these organic chemicals industrial categories after PSES. Thus, other industrial categories account for the majority of the top 10 organic hazardous constituent loadings in the after PSES scenario. Again, several industrial categories exempt from regulation under categorical standards or regulated for metal pollutant parameters only appear in the top 10 hazardous constituent loadings, but in this instance for priority organics (i.e., equipment manufacturing and assembly, pharmaceutical manufacturing, industrial and commercial laundries, and textile mills).

In terms of total hazardous constituent (priority pollutant) loadings, the electroplating/metal finishing industrial category ranks first and accounts for almost 40 percent of the total raw loadings of the top 10. The organic chemicals industries dominate the current loadings of the total hazardous constituents and account for approximately 30 percent of total current loading from the top 10 industrial categories. Equipment manufacture and assembly ranks first in total hazardous constituent loadings after PSES.

Equipment manufacturing and assembly combined with the industrial and commercial laundries industrial category, representing two industrial categories unregulated by categorical standards, account for approximately 35 percent of the total hazardous constituent loadings after PSES for the top 10 industrial categories.

Based on data in Appendix G, Table 3-17 presents the top 20 hazardous constituents (priority pollutants) with the highest loadings under the raw, current, and after PSES scenarios. Table 3-17 shows that many of the top 20 hazardous constituents that appear in raw loadings from the selected consent decree industrial categories are either priority metals, organic solvents, or cyanide. The priority metals tend to drop in rankings under the current and after PSES scenarios. This is probably due to the fact that most categorical standards regulate priority metal parameters, and thus a reduction in these loadings would be expected. Alternatively, the priority organic solvents remain high in total loadings in the current and after PSES scenarios due to the lack of regulation of these solvents through categorical standards in many of the selected consent decree industrial categories.

PCBs and pesticides are two groups of hazardous organics that have been of major concern over the past several years. At least for the selected consent decree industrial categories, PCBs were not found in significant quantities. PCBs are now banned from production in the United States, further use of PCBs is strictly regulated, and PCBs are no longer used to the extent that they were in the past. Pesticides were essentially absent from wastewaters discharged to POTWs from facilities within the selected consent decree industrial categories, except where their presence might be expected (i.e., pesticides manufacturing and pesticides formulation). Section 3.2.3 discusses the loadings of hazardous constituents to POTWs for the pesticides manufacturing industrial category. As for the pesticides formulation industrial category, Appendix G provides loadings to POTWs for those hazardous constituents (priority only) utilized in, and identified in the wastewaters of, pesticides formulating facilities. In support of ITD's recent pesticides rulemaking efforts, estimates of specific pesticide active ingredients loadings to POTWs were determined. Following is a summary of these estimated

TABLE 3-17. TOP TWENTY HAZARDOUS CONSTITUENTS (PRIORITY POLLUTANTS) WITH THE HIGHEST LOADINGS FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1]

HAZARDOUS CONSTITUENT	RAW LOADING (kkg/year)
Chromium and Compounds	30,194
Nickel and Compounds	14,521
Cyanide	14,424
Phenol	13,002
Methylene Chloride	5,681
1,1,1-Trichloroethane	5,074
Lead and Compounds	5,002
Toluene	4,107
Benzene	2,320
Ethyl Benzene	2,239
Trichloroethylene	2,211
Tetrachloroethylene	1,997
Chloroform	1,947
Bis(2-Ethyl Hexyl) Phthalate	1,313
2,4-Dimethyl Phenol	1,158
Naphthalene	1,147
Silver and Compounds	901
Arsenic and Compounds	803
Butyl Benzyl Phthalate	793
Acrolein	785

HAZARDOUS CONSTITUENT	CURRENT LOADING (kkg/year)
Phenol	10,739
Methylene Chloride	5,480
1,1,1-Trichloroethane	3,925
Toluene	3,618
Ethyl Benzene	2,179
Chromium and Compounds	2,058
Chloroform	1,900
Benzene	1,859
Trichloroethylene	1,725
Lead and Compounds	1,563
Tetrachloroethylene	1,506
Nickel and Compounds	1,452
Cyanide	1,436
Bis(2-Ethyl Hexyl)Phthalate	1,207
Naphthalene	917
2,4-Dimethyl Phenol	789
Silver and Compounds	749
Acrolein	748
Butyl Benzyl Phthalate	732
Arsenic and Compounds	704

TABLE 3-17. TOP TWENTY HAZARDOUS CONSTITUENTS (PRIORITY POLLUTANTS) WITH THE HIGHEST LOADINGS FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1] (Continued)

HAZARDOUS CONSTITUENT	AFTER PSES LOADING (kkg/year)
Methylene Chloride	5,399
1,1,1-Trichloroethane	3,924
Toluene	2,012
Trichloroethylene	1,720
Tetrachloroethylene	1,410
Ethyl Benzene	1,189
Chromium and Compounds	1,142
Chloroform	1,142
Antimony and Compounds	986
Phenol	929
Nickel and Compounds	790
Butyl Benzyl Phthalate	670
Cyanide	631
Benzene	564
Bis(2-Ethyl Hexyl)Phthalate	532
Lead and Compounds	519
Silver and Compounds	360
2,4-Dimethylphenol	234
Naphthalene	212
1,2-Dichloroethane	120

[1] Loadings estimates are based largely on ITD data sources, but may include some data derived from ISDB data for the organics industries.

loadings to POTWs from pesticides formulators for those pesticides that also are considered hazardous constituents:

Pesticide Hazardous Constituent Group	Current Loading (kg/yr)	After PSES Loading (kg/yr)
Disulfoton, Diazinon, Dichlorvos, Naled, Pyrethrins, and related Pyrethrin compounds	764	751
Carbaryl, Chloropyrifos, Deet, Malathion, Propanil, Propoxur, 3,4-Dichloroaniline	183	18

Table 3-18 presents the total volatile and ignitable/reactive hazardous constituents loadings (priority pollutants) for each of the selected consent decree industrial categories. The loadings presented in Table 3-18 are derived by adding the specific priority hazardous constituents considered volatile and ignitable/reactive for this study and described in Chapter 2. As discussed previously, because many of these constituents are discharged at low concentrations or are only marginally volatile, discharge of these constituents to POTWs may not always result in volatilization or explosions. The purpose of Table 3-18 is to gauge the extent of discharge of RCRA characteristic wastes from the selected consent decree industrial categories as measured by specific hazardous constituents that are considered volatile or ignitable/reactive. As illustrated in Table 3-18, two industrial categories that are not associated with the organic chemicals industrial categories are responsible for the two largest loadings of volatile hazardous constituents. These two industrial categories are equipment manufacture and assembly and pharmaceutical manufacturing. As described earlier, these two industrial categories also are not regulated by categorical standards for organic hazardous constituents, many of which also are considered volatile.

3.3.4 Analysis of Other Pertinent Data for the Selected Consent Decree Industrial Categories

In addition to the data extracted from the DSS Industrial Profile Forms provided by EPA and supplemented by ITD Development Documents and data bases, data were incorporated from additional sources. The supplemental data

TABLE 3-18. LOADINGS OF TOTAL VOLATILE POLLUTANTS (TVP) AND TOTAL IGNITABLE/REACTIVE POLLUTANTS (TI/RP) FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES*

INDUSTRIAL CATEGORY	TVP LOADINGS* (kg/yr)			TI/RP LOADINGS* (kg/yr)		
	RAW	CURRENT	AFTER PSES	RAW	CURRENT	AFTER PSES
Adhesives & Sealants	32,707	18,002	18,002	5,895	5,836	5,836
Battery Mfg.	912	5	5	47	3	3
Dyes & Pigments (ITD)	2,528	2,528	29	2,520	2,520	22
Dyes & Pigments (ISDB)	26,060	26,060	118	3,885	3,885	97
Electrical & Electronic Comp.	202,644	20,348	20,348	3,879	1,175	1,175
Electroplating & Metal Finishing	2,303,223	41,987	41,987	8,002,298	148,964	148,964
Equipment Mfg. & Assembly	7,714,928	7,714,928	7,714,928	381,927	381,927	381,927
Explosive Mfg.	0	0	0	1	1	1
Gum & Wood Chemicals	43,047	43,047	43,047	35,105	35,105	35,105
Industrial & Comm. Laundries	380,927	380,917	380,917	289,891	289,891	289,891
Ink Mfg. & Formulation	64	64	64	37	37	37
Inorganic Chemicals Mfg.	13,303	200	200	0	0	0
Iron & Steel Manufacturing	444,435	72,758	72,758	1,227,819	143,208	143,208
Leather Tanning & Finishing	12,699	10,284	10,284	8,852	7,180	7,180
Nonferrous Metals Forming	N/A	N/A	N/A	1,205	149	149
Nonferrous Metals Mfg.	923	554	554	252	249	249
Organic Chemicals Mfg. (ITD)	1,649,746	1,576,830	2,961	2,379,952	2,276,539	2,426
Organic Chemicals Mfg. (ISDB)	4,390,912	4,227,327	65,151	3,882,678	3,767,671	5,630

TABLE 3-18. LOADINGS OF TOTAL VOLATILE POLLUTANTS (TVP) AND TOTAL IGNITABLE/REACTIVE POLLUTANTS (TI/RP) FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES* (Continued)

INDUSTRIAL CATEGORY	TVP LOADINGS* (kg/yr)			TI/RP LOADINGS* (kg/yr)		
	RAW	CURRENT	AFTER PSES	RAW	CURRENT	AFTER PSES
Paint Mfg. & Formulation	47,075	40,234	40,234	32,561	27,558	27,558
Pesticides Mfg. (ITD)	2,165,868	1,082,934	389	2,718,248	1,359,124	391
Pesticides Mfg. (ISDB)	333,098	16,549	138	287,878	143,939	16
Pesticides Formulation (ITD)	N/A	249	0	N/A	29	0
Petroleum Refining	1,218,364	1,218,364	1,218,364	1,537,976	1,537,976	1,537,976
Pharmaceutical Mfg.	6,994,833	6,994,833	6,994,833	5,846,715	1,319,073	1,319,073
Photo. Chemicals & Film Mfg.	463	430	430	2,229	1,867	1,867
Plastics Molding & Forming	4,447	4,447	4,447	1,011	1,011	1,011
Plastics, Resins & Syn. Fibers (ITD)	110,005	91,020	550	110,126	92,059	498
Plastics, Resins, & Synthetic Fibers (ISDB)	852,005	727,610	9,396	852,972	728,577	9,400
Porcelain Enameling	219	184	184	107	90	90
Printing & Publishing	11,399	10,591	10,591	23,066	21,513	21,513
Pulp & Paper Mills	576,992	576,992	576,992	375,260	375,260	375,260
Rubber Mfg.	15,093	15,093	15,093	15,093	15,093	15,093
Textile Mills	252,527	252,527	252,527	184,117	184,117	184,117
Timber Products	3,268	3,268	3,268	2,933	1,616	1,616

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*Priority volatile and ignitable/reactive constituents only. Unless otherwise specified, loadings estimates are derived from ITD data sources.

gathered assisted in filling data gaps, such as the presence of nonpriority hazardous constituents and specific listed hazardous wastes being generated and/or discharged to POTWs, as well as in augmenting priority hazardous constituent data gathered from ITD.

Several additional data sources have been identified and evaluated for possible use in the DSS. These are:

- OSW SQG Survey Data
- OW Paragraph 4(c) Sampling Data
- OSW Hazardous Waste Data Management System
- State/Local Industrial Data
- Industrial Incidents Files.

3.3.4.1 OSW SQG Survey Data

In the preamble to the 1980 RCRA regulations, EPA stated that, based on available data, 99 percent of hazardous waste generators produce less than 1,000 kg/month of hazardous waste and that this represents less than 1 percent of the total hazardous waste generated.(2) Therefore, the Agency initially suggested an exclusion level for those facilities that generate less than 1,000 kg/month of hazardous waste. These facilities exempted from full regulation under RCRA often are referred to as SQGs. In the 1984 RCRA Amendments, Congress added provisions, applicable to these SQGs, which will result in changes to the current regulations. Under the new provisions, facilities that generate 100 kg/month, but less than 1,000 kg/month, will have to comply with those requirements that cover the transportation and disposal of hazardous waste.(3) The SQG Survey was conducted for OSW to assemble information necessary to determine the economic and environmental implications of the available regulatory options.

The major objectives of the SQG Survey were to develop reliable estimates of the types and numbers of SQGs, to identify types and quantities of hazardous waste generated by these facilities, and to describe the methods by which those wastes are managed.(4) Approximately 50,000 of the estimated 600,000-660,000 establishments that were considered SQGs were surveyed, resulting in a data base containing nearly 19,000 responses. One hundred and twenty-five SIC codes were chosen for inclusion in the survey and combined into 22 larger industry groups; the remaining SIC codes were excluded from the survey because they were similar to those already included or because they were unlikely to contain significant numbers of SQGs. These industry groupings were determined primarily according to waste types that the establishments in each of the SIC codes were expected to generate. For each wastestream, respondents were asked to indicate whether or not the firm generated the waste, the quantity of waste generated, and how the waste was managed and disposed. Two limitations exist in the survey data. First, some double counting of SQGs and associated waste quantities exists when examining breakdowns by management practices. Second, the results of the survey are two-tiered: respondents provided detailed reports of their generation and handling practices that were specifically targeted for their type of establishment, while for additional nontargeted wastes, they reported wastes that were generated, but did not provide any indepth information concerning waste quantities or management practices.

The SQG Survey data base was useful to the DSS since it provided hazardous waste generation and disposal information for the SQGs within each industrial category. Detailed data are presented for onsite storage, treatment, recycling, and disposal activities, including discharge to POTWs. Using the responses from the survey, the data were weighted using statistical models along with knowledge of the industrial categories to estimate the total number of SQGs in each industry and the amount of hazardous waste discharged annually. A summary of the hazardous wastes discharged by SQGs to POTWs is shown in Table 3-19 (the selected consent decree industrial categories are shown in bold face).

The hazardous waste quantities shown in Table 3-19 represent only the SQG segment of an industrial category. For a few selected consent decree industrial categories made up predominantly of SQGs (i.e., industrial and commercial laundries, printing and publishing), these hazardous waste quantities in Table 3-19 may be representative of the entire industrial category. However, for many of the other selected consent decree industrial categories,

TABLE 3-19. NUMBER OF INDIRECT DISCHARGES AND HAZARDOUS WASTE QUANTITIES FOR SMALL QUANTITY GENERATORS[1]

Industrial Category	Unweighted # of Facilities in Survey	Weighted Total # of Facilities	Weighted # of Facilities Discharging to POTW	Weighted Total Quantity of Hazardous Waste Discharged to POTW (Kg/year)	Weighted Total Quantity of Hazardous Waste Discharged to POTW Per Facility (Kg/year)
Battery Manufacturing	3	5	0	0	---
Construction Industry	86	16,988	1,076	242,088	225
Cosmetics, Frangrances, Etc.	56	209	33	69,960	2,120
Electrical & Electrical Components	9	1,247	148	1,693,548	11,440
Electroplating/Metal Finishing	65	6,196	1,490	3,252,264	2,180
Equipment Manufacturing	258	30,027	2,424	5,423,8[illegible]	2,240
Explosives Manufacturing	59	209	27	27	1,030
Fertilizer Manufacturing	43	129	17	22	1,330
Gum & Wood Chemicals & Related Oils	4	11	0	0	---
Industrial & Commercial Laundries	530	15,625	1,157	1,514,508	1,310
Ink Manufacturing	61	228	35	71,076	2,030
Inorganic Chemicals Manufacturing	46	134	20	22,572	1,130
Iron & Steel Manufacturing	11	838	57	264,780	4,650
Laboratories & Hospitals	333	5,643	2,926	2,099,664	720
Leather Tanning & Finishing	12	230	19	8,832	465
Misc. Chemicals Formulation	169	565	80	188,316	2,350
Motor Vehicles Services	292	191,901	3,587	1,318,860	370
Nonferrous Metals Forming	3	207	0	0	---
Organic Chemicals, Plas., & Syn. Fibers	84	262	29	77,484	2,670
Pesticides Manufacturing	29	115	12	14,112	1,180
Pharmaceuticals Manufacturing	63	247	32	46,056	1,440
Photographic Chemicals & Film	4	251	21	7,068	335
Plastics Molding & Forming	192	2,306	136	142,776	1,050
Porcelain Enameling	8	662	28	144	5
Printing & Publishing	482	24,150	14,293	9,187,116	640
Pulp & Paper Mills	95	626	71	118,356	1,670
Rubber Manufacturing & Processing	22	67	0	0	---
Service Related Industries	1,716	43,930	23,395	23,146,068	990
Soap & Detergents	170	602	209	621,168	2,970
Stone, Clay, Glass, Etc.	13	104	0	0	---
Textile Mills	55	273	73	127,284	1,740
Timber Products Processing	121	946	30	33,684	1,120
Transportation Services	213	28,951	582	26,436	45
Wholesale & Retail Trade	119	5,733	366	160,020	440
Wood Furniture Manufacture	102	2,393	200	399,696	2,000
TOTAL	5,529	382,010	52,573	50,328,180	960

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[1] Derived from Reference (5)

these SQG facilities represent only a small fraction of a larger industrial category. Thus, the hazardous waste quantities presented for these industrial categories in Table 3-19 are not totally representative.

In addition, the categorization of industries in the DSS differs from the categorization chosen in the SQG Survey. SIC codes grouped as a unit in the SQG Survey were separated into various industrial categories in this report. Breaking up these clusters of representative SIC codes causes the statistical validity of the information to decrease. Careful consideration was taken in the incorporation of the 125 SIC codes used in the SQG Survey into the 47 industrial categories utilized in this study in order to obtain a representative sampling. Separation of SIC codes was minimized whenever possible to keep the usefulness of the SQG Survey to this project as high as possible (the breakdown of SIC codes into industrial categories is shown in Appendix C).

Finally, some double counting of waste quantities discharged to POTWs occurred occasionally due to the restructuring of industrial categories for this study. In a few instances, a SIC code fell into more than one industrial category, which caused the waste quantity associated with this SIC code to appear twice (e.g., SIC 3679 appears in the electrical and electronic components industrial category as well as the electroplating/metal finishing industrial category). The effect of double counting is estimated to increase the total quantity of waste discharged to POTWs, shown in Table 3-19, by approximately 5 percent (from 47,754 metric tons/year to 50,328 metric tons/year).

Table 3-19 shows the printing and publishing (9,187,116 kg/yr), equipment manufacture and assembly (5,423,820 kg/yr), and industrial and commercial laundries (1,514,508 kg/yr) industrial categories together account for over 45 percent of the total quantity of hazardous wastes discharged to POTWs from SQGs within the consent decree industrial categories. From a different perspective, the SQG segment of the electrical and electronic components industrial category has the highest quantity per facility (11,440 kg/yr) of hazardous waste discharged to POTWs by SQGs.

The SQG Survey data do not include specific constituents found in the hazardous waste discharges, but rather describe generic waste types, such as ignitable wastes, photographic wastes, and wastewater wood preservatives. Table 3-20 lists the wastetype(s) that account for at least 90 percent of the waste quantity discharged to POTWs by industrial category, and attempts to identify typical constituents for each industry that would account for the hazardous nature of the waste. References used to characterize the waste types included sources such as:

- Encyclopedia of Chemical Technology, Kirk-Othmer
- Chemical Process Industries, Shreve & Brink
- OSW Hazardous Waste Data Management System.

The hazardous waste constituents shown in Table 3-20 are compounds that would be representative of the composition of the waste type(s), but are by no means the only possible constituents for the waste type(s) present in each industrial category.

3.3.4.2 OW Paragraph 4(c) Data Base

Paragraph 4(c) of the NRDC Consent Decree required EPA to identify pollutants, other than the priority pollutants, being discharged to POTWs and not susceptible to treatment or otherwise incompatible with the POTW. EPA's Athens Environmental Research Laboratory (AERL) established a program in 1978 to identify these nonpriority pollutants in industrial effluent samples collected during the categorical standards development process.(6) Samples were analyzed from POTWs and over 40 industrial categories. A total of 1,565 compounds were detected at least once after comparing mass spectra from the GC/MS runs to mass spectra of known compounds in the EPA/NIH library. Frequency-of-occurrence and order-of-magnitude concentrations were determined for each compound. Each compound then was ranked according to frequency and apparent concentration. AERL then determined whether an extract from the original organic analyses of the samples was still available. Only 717 compounds were determined to be likely to be present in the available sample extracts. A program was undertaken in which 385 of the 717 compounds were confirmed to be present at apparent concentrations in the extracts. Many of

TABLE 3-20. SMALL QUANTITY GENERATOR HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1]

INDUSTRIAL CATEGORY*	TOTAL QUANTITY HAZARDOUS WASTE DISCHARGED TO POTWs (kg/yr)	HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY	TYPICAL HAZARDOUS WASTE CONSTITUENTS
Electrical & Electronic Components	1,693,548	Strong Acid or Alkaline Wastes (80%) Spent Plating Wastes (10%)	nitric acid, fluorides, arsenic, sodium phosphate, sodium carbonate, sodium hydroxide, chromium
Electroplating/Metal Finishing	3,252,264	Spent Plating Wastes (50%) Strong Acid or Alkaline Wastes (45%)	heavy metals, chlorinated hydrocarbons, fluorides, sodium hydroxide, cyanide
Equipment Manufacturing	5,423,820	Strong Acid or Alkaline Wastes (70%) Spent Plating Wastes (20%)	heavy metals, chlorinated hydrocarbons, fluorides, sodium hydroxide, cyanide
Explosives	27,852	Strong Acid or Alkaline Wastes (98%)	nitric acid, sulfuric acid
Ind. & Comm. Laundries	1,514,508	Filtration Residue from Dry Cleaning (99%)	tetrachloroethylene, petroleum solvents
Ink Manufacture & Formulation	71,076	Strong Acid or Alkaline Wastes (50%) Heavy Metal Solutions (35%) Spent Solvents (10%)	lead, cadmium, chromium, mercury, cyanide, alcohols, esters, ketones, aromatic hydrocarbons
Inorganic Chemicals	22,572	Strong Acid or Alkaline Wastes (100%)	assorted acids and caustics
Iron & Steel Manufacturing	264,780	Strong Acid or Alkaline Wastes (100%)	sulfuric acid, hydrochloric acid
Leather Tanning & Finishing	8,832	Spent Solvents (100%)	dimethylamine, formaldehyde
Organic Chemicals	77,484	Strong Acid or Alkaline Waste (50%) Ignitable Wastes (25%) Photographic Wastes (15%)	hydrochloric acid, sulfuric acids, assorted organics, heavy metals
Pesticides Manufacturing	14,112	Pesticide Washing & Rinsing Solutions (100%)	assorted pesticides
Pharmaceuticals	46,056	Strong Acid or Alkaline Wastes (60%) Ignitable Wastes (40%)	acetone, isopropyl alcohol, toluene, methylene chloride
Photographic Chemicals	7,068	Solution or Sludges with Photosilver (65%) Spent Solvents (35%)	silver, cyanide, chromium, benzene derivatives

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[1] Only industries that contain SQG Survey data are shown.

TABLE 3-20. SMALL QUANTITY GENERATOR HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY FOR SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES[1] (Continued)

INDUSTRIAL CATEGORY*	TOTAL QUANTITY HAZARDOUS WASTE DISCHARGED TO POTWs (kg/yr.)	HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY	TYPICAL HAZARDOUS WASTE CONSTITUENTS
Plastics Molding & Forming	142,776	Ignitable Wastes (55%) Spent Solvents (45%)	monomers (styrene, phenol, butadiene, etc.), phthalates
Porcelain Enameling	144	Strong Acid or Alkaline Wastes (100%)	boric acid, sodium carbonate
Printing & Publishing	9,187,116	Photographic Wastes (75%) Strong Acid or Alkaline Wastes (10%) Spent Solvents (10%)	silver, cyanide, chromium, ketones, alcohols, esters, aromatic hydrocarbons
Pulp & Paper	118,356	Spent Solvents (55%) Strong Acid or Alkaline Wastes (40%)	formaldehyde, dyes and pigments, sulfuric acid, sodium hydroxide
Textile Mills	127,284	Spent Solvents (90%) Solution or Sludges with Photosilver (10%)	acrylonitrile, chlorinated phenols, silver, cyanide, formaldehyde
Timber Products	33,684	Wastewater Wood Preservatives (99%)	pentachlorophenol, creosote, arsenic

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[1] Only industries that contain SQG Survey data are shown.

the sample extracts were several years old when analyzed, and thus volatiles probably were not confirmed and concentrations may have changed due to degradation. Fifty-six of these compounds were determined to be incompatible with POTWs, and 18 of these compounds were recommended for toxicity reviews, based on a review of production/use and environmental fate information. The remaining 38 compounds were deleted since it was believed that those compounds are discharged only in trace amounts to POTWs.

Table 3-21 summarizes the information collected by the Paragraph 4(c) study for the selected consent decree industrial categories. Detections of nonpriority hazardous constituents and the relative number of hazardous constituents that appeared in wastes from each industrial category are provided. As described above, the Paragraph 4(c) data base lists concentrations and frequencies of nonpriority hazardous constituents; however, it does not give conclusive results. Constituent concentrations were "apparent concentrations" based on matching of mass spectra found to library mass spectra, and frequencies in the data base refer to the total number of "apparent" detections of each compound. Therefore, it is difficult to determine whether the detections occurred in one plant, several plants, or a large number of plants. There were no flow rates associated with the apparent concentrations provided, so mass loadings could not be calculated using the data base.

Examining Table 3-21, the most predominant nonpriority hazardous constituents detected in the selected consent decree industrial categories are as follows:

Nonpriority Hazardous Constituent	Number of Industrial Categories Detected
Cresols	18
Xylene	18
Acetophenone	17
Methyl Ethyl Ketone	16
Acetone	15

These hazardous constituents would be expected to appear in the wastewaters in many industrial categories because of their common use as solvents.

TABLE 3-21. RESULTS FROM PARAGRAPH 4(c) STUDY FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES

Hazardous Nonpriority Constituents * / Industrial Category	Adhesives and Sealants	Battery Manufacturing	Coal, Oil, Petroleum Products and Refining	Dye Manufacture and Formulation	Electrical and Electronic Components	Electroplating and Metal Finishing	Equipment Manufacture	Explosives Manufacture	Gum and Wood Chem. and Related Oils	Industrial and Commercial Laundries	Ink Manufacture and Formulation	Inorganic Chemicals Manufacture	Iron and Steel Manufacture and Forming	Leather Tanning and Finishing	Nonferrous Metals Forming	Nonferrous Metals Manufacture	Organic Chemicals, Plas., Resins, and Syn. Fibers	Paint Manufacture and Formulation	Pesticides Manufacturing and Formulation	Pharmaceutical Manufacturing	Photographic Chem. and Film Manufacturing	Plastics Molding and Forming	Porcelain Enameling	Pulp and Paper	Printing and Publishing	Textile Mills	Timber Products Processing	Total
Acetone					x		x			x	x	x		x			x	x	x	x	x	x	x		x	x		15
Acetophenone			x		x		x				x	x	x		x	x	x	x	x	x		x		x	x		x	16
Aniline							x			x		x	x	x		x	x		x	x							x	10
p-Benzoquinone		x															x				x	x					x	5
Benzyl Chloride			x								x	x			x	x	x	x		x		x						9
N-Butyl Alcohol					x		x				x			x				x		x								6
Carbon Disulfide											x			x			x	x	x			x		x				7
Cresols			x		x		x			x	x	x	x	x	x	x	x	x		x	x	x		x		x	x	18
Cumene			x				x										x		x			x						5
Cyclohexane							x			x							x		x		x					x	x	7
Cyclohexanone						x				x												x						3
1,4-Dioxane											x						x	x	x		x							5
Diphenyl Amine			x					x		x	x	x	x		x	x	x	x							x			11
Epichlorohydrin							x																					1
Ethyl Acetate					x		x				x		x			x	x	x			x	x			x			10
Ethyl Ether					x						x	x					x	x							x			6
Furfural					x																							1
Isobutanol			x		x						x						x	x	x	x		x			x			9
Methyl Ethyl Ketone			x		x	x	x			x	x	x	x	x	x		x	x	x	x				x	x			15
Methyl Isobutyl Ketone					x		x				x	x	x				x	x				x	x	x	x			11
Pentachloroethane												x																1
2-Picoline																				x							x	2
Pyridine											x	x						x		x							x	5
1,1,1,2-Tetrachloroethane					x					x		x					x									x		5
Tetrahydrofuran					x						x	x					x	x								x		6
1,2,3-Trichloropropane					x							x			x	x	x							x	x			7
1,1,2-Trichloro-1,2,2-Trifluoroethane							x					x						x	x		x	x				x		7
Xylene			x		x		x				x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	18
TOTAL	0	1	8	ND	14	2	13	1	0	8	16	16	8	6	7	7	20	17	11	11	8	13	13	7	10	7	8	

*Nonpriority Pollutants Not Listed Were Undetected in Every Industrial Category

ND - No Data

Nonpriority hazardous constituents were detected in the majority of those selected consent decree industrial categories evaluated in the Paragraph 4(c) study. Those selected consent decree industrial categories with the most nonpriority hazardous constituents detected are as follows:

Industrial Category	Number of Nonpriority Hazardous Constituents Detected
Organic Chemicals, Plastics, Resins, and Synthetic Fibers	20
Paint Manufacture and Formulation	17
Ink Manufacture and Formulation	16
Inorganic Chemicals Manufacture	16
Electrical and Electronic Components	14

Certain industrial categories were represented by many facilities in the Paragraph 4(c) study, and several industrial categories were represented by only a few facilities. Therefore, the data for some industrial categories may be representative of the entire industry, while for other industrial categories it may not.

3.3.4.3 Hazardous Waste Data Management System

The Hazardous Waste Data Management System (HWDMS) is a data base maintained by OSW to track the permit, compliance, and enforcement status of RCRA hazardous waste handlers. The data base contains information for over 90,000 facilities. The facilities are classified as hazardous waste generators, transporters, treatment, storage, and/or disposal (TSD) facilities, or nonregulated. Over 300 different data elements are used in HWDMS in describing these facilities. The data elements are updated weekly by EPA Regional Offices.

Regarding this study, much of the data contained in HWDMS were useful in several ways. During the initial stages of the study, HWDMS was used to identify the extent of hazardous waste activity for each 4-digit SIC code representing an industrial category. After industry categorization, the HWDMS data were used to describe the waste types generated in each industrial category. The data base also identifies RCRA permitted POTWs that are hazardous waste generators, TSD facilities, or transporters.

There are several limitations in using the HWDMS data. First, there may have been problems with precautionary notification by facilities who received the initial questionnaire from OSW. In short, there is a possibility that a few facilities listed all hazardous wastes believed to be generated or handled at that time or that could conceivably be generated or handled in the future. Industry's concern was that if a waste was not recorded on the initial questionnaire, a facility would not ever be allowed to generate or handle that hazardous waste. Therefore, as a precaution, some facilities may have listed almost every possible characteristic and listed waste identified by EPA. Secondly, double counting also has the potential to be a problem with HWDMS since each facility may list up to four SIC codes when notifying OSW. Therefore, waste data extracted from HWDMS may be counted in up to four industrial categories. In general, however, the majority of the facilities included in HWDMS did not notify under several SIC codes or, if more than one was listed, quite often fell into the same industrial category. Lastly, the HWDMS data base does not provide specific information regarding which of the facilities notifying are indirect dischargers. Therefore, information extracted from HWDMS is applicable to an industrial category as a whole, and represents direct, indirect, and zero dischargers.

Appendix H presents a summary of the HWDMS data base for the selected consent decree industrial categories. Approximately 240 RCRA characteristic and listed wastes were found for the 30 selected consent decree industrial categories. Hazardous wastes that appear in the most industrial categories include the characteristic D-listed hazardous wastes (ignitable, corrosive, reactive), the F-listed solvents (halogenated and nonhalogenated), and the EP toxic metals (primarily lead and chromium). In general, these wastes appear in almost all the selected consent decree industrial categories, with the exception of industrial and commercial laundries, which had no data in HWDMS. The solvent that appeared in the most industrial categories was acetone (present in 24 selected consent decree industrial categories), followed by toluene, 1,1,1-trichloroethane, and methanol (present in 22 industrial categories each).

Industrial categories that had the most types of listed wastes (in descending order) were equipment manufacturing and assembly (135), inorganic chemicals manufacturing (127), organic chemicals manufacturing (125), adhesives and sealants (117), and plastics molding and forming (117). These industrial categories are expected to contain a variety of wastes because of the diversity of the products they make. The HWDMS data base brings out this fact in that the larger the scope of products associated with an industrial category, the more numerous the hazardous wastes associated with these industries.

3.3.4.4 EPA Region/State/POTW Data

In an effort to augment information gathered from the OW and OSW industrial data bases, data were collected from various EPA Regions, States, and POTWs for the industrial categories evaluated during this study. The first step was the development of a list of potential sources of industrial hazardous waste data. After all potential sources of industrial hazardous waste data were identified, data were collected via one of three methods: telephone requests, written requests, and site visits. Generally, data collected included wastewater flow rates and hazardous constituent concentrations in those wastewaters discharged to POTWs from any of the industrial categories evaluated during this study. Although data were collected for all industrial categories and for all hazardous constituents considered in this study, emphasis was put on the collection of data for industrial categories where little or no hazardous waste information existed.

Representativeness of data for specific industrial categories varied, ranging from electroplating/metal finishing (141 facilities represented) to porcelain enameling and gum and wood chemicals (1 facility each represented). A detailed discussion regarding the methodologies utilized for the collection of the data considered in this study, as well as a complete summary of the data collected from these State/local sources for the industrial categories is provided in Appendix I. Pollutants not detected or zero concentrations were not taken into account. Therefore, the average concentrations shown in Appendix I are not actual averages, but rather only mean values of the nonzero concentrations. Further, in the majority of cases, the sample type (i.e., grab, 24-hour composite) was not indicated for the data collected. Therefore, the average concentrations shown in Appendix I may have been calculated using both instantaneous and long-term hazardous constituent concentrations.

Due to the limitations described above and the large amount of data contained in Appendix I, it would be difficult to summarize the State and local industrial data. Therefore, analysis of the State and local data, as it pertains to specific selected consent decree industrial categories, will be incorporated into Section 3.3.5, which summarizes the data presented throughout Section 3.3.

In an effort to further supplement data gathered for this study, a sampling program was initiated by EPA specifically for this study. The goal of this sampling program was to identify the hazardous constituents present in indirect discharges from selected industrial facilities and present in the influents and effluents at two POTWs. The industrial facilities selected for this sampling program included a pharmaceutical manufacturer, a solvent recovery facility, a paint manufacturer, and an industrial laundry. Of the two POTWs sampled, one was considered heavily industrialized, while the other predominantly serviced residential and commercial customers. The data resulting from this sampling program are presented in Appendix J. This appendix also provides the detection limits and analytical methods utilized for all the parameters monitored during this study. Specific data for the applicable industrial facilities will be discussed within Sections 3.3.5 and 3.4.2 as they relate to each industrial category.

3.3.4.5 Industrial Incidents File

In order to evaluate further the effect of hazardous waste discharges on POTWs from facilities within the various industrial categories, information was gathered on specific incidents that have occurred at POTWs that were caused by hazardous waste discharges from industrial users. The data for these incidents were gathered primarily via one of three methods: a survey distributed by the Association of Metropolitan Sewerage Agencies (AMSA) to its members; a telephone survey of POTWs referred to by EPA Region and State representatives as having specific incidents involving industrial hazardous waste discharges; and documentation of incidents from technical journals, newspapers; and other periodicals. Appendix K provides a more detailed discussion on the collection of the incidents data and provides a summary of those incidents that have occurred at POTWs.

The summary table in Appendix K for the selected consent decree industrial categories shows the impact of hazardous waste or constituent discharges on POTW operations. Analysis of specific incidents involving the selected consent decree industrial categories will be incorporated into the following section, which summarizes data presented throughout Section 3.3. Several of the incidents described above were the result of a spill of a hazardous waste or constituent within an industrial facility. Therefore, the information in Appendix K does not necessarily represent typical hazardous waste discharge practices for a given industrial category. Appendix K should only provide a sense of the types of hazardous wastes handled by facilities within an industrial category and the potential problems associated with the discharge of these hazardous wastes or constituents to POTWs.

3.3.5 Summary of Hazardous Waste and Constituent Data Presented for the Selected Consent Decree Industrial Categories

This section summarizes the hazardous waste and constituent data presented throughout Section 3.3 for the selected consent decree industrial categories. This summary will concentrate on those selected consent decree industrial categories that, according to the data presented, may be responsible for the discharge of significant quantities of hazardous wastes or constituents to POTWs. However, this summary should not imply that those industrial categories discussed in this section are the only industrial categories that discharge or have the potential to discharge hazardous wastes or constituents to POTWs. This is due primarily to the fact that limited hazardous waste data exist for industrial categories, or data that do exist are outdated and may not properly characterize hazardous waste practices for an industrial category. This is especially true for the adhesives and sealants and rubber manufacturing and processing industrial categories for which limited data currently exist.

3.3.5.1 Electroplating/Metal Finishing

The electroplating/metal finishing category is responsible for the discharge of significant quantities of hazardous wastes to POTWs, as shown by ITD hazardous constituent (priority only) loadings (45,970,546 kg/yr raw, 1,191,607 kg/yr current and after PSES) and SQG Survey hazardous waste loadings (3,252,264 kg/yr) for the SQG segment of the category. Also, many POTW incidents have occurred as a result of hazardous constituent discharges (primarily acids, metals, and organic solvents) from facilities within the electroplating/metal finishing category. Results from the AMSA survey (as described in Appendix K) found electroplating/metal finishing facilities to be considered "problem industries" in 31 of the 66 POTWs surveyed. Analysis of State and local data presented in Appendix I for the electroplating/metal finishing industrial category also shows high average concentrations for several hazardous priority metals (i.e., chromium, nickel) and several hazardous priority and nonpriority organics (i.e., acetone, toluene, ethyl benzene, 1,1,1-trichloroethane). However, due to the attention the electroplating/metal finishing category has received from a regulatory standpoint (i.e., promulgation of categorical standards and RCRA listed wastestreams), the category as a whole may not be as great of a concern as the data may indicate, assuming that applicable wastewater discharge and hazardous waste regulations are enforced against electroplating/ metal finishing facilities. This would ensure control of hazardous priority metals and organics.

Alternatively, a concern does arise for the electroplating/metal finishing category in terms of the use and discharge of nonpriority hazardous organics. The HWDMS data base (see Appendix H) shows that several RCRA hazardous wastes are associated with electroplating/metal finishing facilities. Specifically, several hazardous nonpriority organics, such as acetone (U002), methanol (U154), methyl ethyl ketone (U159), and xylene (U239), were present. Therefore, even with the compliance by electroplating/metal finishing facilities with categorical standards (specifically the total toxic organics limitation), other nonpriority hazardous constituents currently may be used and discharged to POTWs. An estimation of the quantities of these hazardous nonpriority organics could not be made for this study.

3.3.5.2 Pharmaceuticals Manufacturing

Another selected consent decree industrial category that is of concern from the standpoint of significant hazardous waste and constituent discharges to POTWs is the pharmaceuticals manufacturing industrial category. There are several reasons for concern in this industry, one of which stems from the incidents that have occurred at POTWs due to wastewater discharges containing hazardous constituents, particularly organics, from facilities within the pharmaceutical manufacturing category. These incidents have resulted mainly in potential explosion situations. Also, the pharmaceutical manufacturing industrial category ranks second in total hazardous constituent (priority pollutant) loadings after the implementation of categorical pretreatment standards (total cyanide is the only pollutant parameter regulated for the pharmaceutical manufacturing category). As shown in Table 3-18 and Appendix G, significant loadings of several volatile hazardous constituents (priority pollutants) are estimated to be discharged currently by the pharmaceutical manufacturing category. Specifically, the following are found in significant quantities:

Volatile Hazardous Constituent (Priority Pollutant)	Annual Loading (kg/yr)
Chloroform	890,108
Methylene Chloride	4,779,851
Toluene	787,777

In May 1983, a 6-day sampling study performed for EPA simultaneously evaluated pollutant concentrations at a pharmaceutical manufacturing facility and the POTW to which the facility's wastewaters were discharged.(7) Detectable concentrations in the plant effluent of methylene chloride, phenol, toluene, naphthalene, and isophorone were observed. Concentrations of methylene chloride as high as 166,000 ug/l were detected in the effluent from the industrial facility. The following is a summary of the average daily discharge of hazardous organic constituents found in the facility's effluent:

Hazardous Constituent	Daily Facility Effluent (kg/day)
Methylene Chloride	101.6
Phenol	12.7
Toluene	0.45
Naphthalene	0.24
Isophorone	0.10

Furthermore, results from this study show that 85 percent of the mass of methylene chloride in the POTW influent (with an average flow of 80 MGD) originates from the pharmaceuticals facility discharge (with an average flow of 1 MGD).

Volatile hazardous constituents (nonpriority pollutants) also are used extensively in the pharmaceuticals manufacturing process. An attempt was made to estimate the total amount of nonpriority volatile organic pollutants discharged to POTWs by the pharmaceutical manufacturing category, based primarily on data from a study performed by Research Triangle Park (RTP) and contained in the ITD Development Document for pharmaceutical manufacturing.(8) The data for this study, representing 26 pharmaceutical facilities accounting for 53 percent of total production within the pharmaceutical industry, were initially supplied to RTP from the Pharmaceutical Manufacturing Association (PMA). Table 3-22 presents the estimates of volatile hazardous constituents (nonpriority) loadings from the Pharmaceutical Manufacturing industrial category. As shown in Table 3-22, there are an estimated 14,800 metric tons of volatile hazardous constituents (nonpriority pollutants only) discharged annually to POTWs from the pharmaceutical manufacturing industrial category. State and local data presented in Appendix I verify that several volatile hazardous constituents are present in wastewaters discharged to POTWs from facilities within the pharmaceutical manufacturing industrial category. Specifically, high average concentrations are shown for acetone (9.65 mg/l), toluene (2.84 mg/l), and xylene (1.00 mg/l). The HWDMS data base, shown in

TABLE 3-22. ESTIMATED LOADINGS OF HAZARDOUS NONPRIORITY VOLATILE ORGANIC POLLUTANTS FOR THE PHARMACEUTICAL MANUFACTURING INDUSTRIAL CATEGORY*

Hazardous Nonpriority Volatile Organic	Estimated Annual Loading (kg/yr)
Methanol	6,695,544
Acetone	4,866,058
Ethyl Acetate	2,093,536
Xylene	961,895
Methyl Ethyl Ketone	56,582
Butanol	56,582
Formaldehyde	37,721
Ethyl Ether	22,633
Acetonitrile	11,316
Pyridine	5,658
TOTAL	14,807,525

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*Estimates were derived from data presented in the September 1983 EPA "Development Document for Final Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Pharmaceutical Manufacturing Point Source Category."

Appendix H, also provides verification of at least the presence of over 80 percent of the hazardous volatile organic constituents (as specific U-listed compounds) considered in this study for the pharmaceutical manufacturing industrial category.

Finally, as described in Section 3.3.4.4 and Appendix J, sampling results from a 1-day sampling event performed by EPA for this study at a pharmaceutical manufacturing facility found significantly high concentrations of priority and nonpriority hazardous organic constituents being discharged to a POTW. Following is a summary of those hazardous constituents found in high concentrations:

Hazardous Constituent	Concentration (ug/l)
Acetone	4,592
Methylene Chloride	2,760
Toluene	1,565
1,2-Dichlorobenzene	2,280
1,2-Dichloroethane	2,497
Methyl Ethyl Ketone	1,566

In summary, it would appear as though the discharge of hazardous constituents (especially nonpriority and priority volatile organics) to POTWs from the pharmaceutical manufacturing category is significant. Due to the lack of regulation of these hazardous constituents for this industry, at least in terms of categorical standards, the pharmaceutical manufacturing industry would also be expected to continue discharging hazardous wastes at or near the levels presented here.

3.3.5.3 Printing and Publishing

The printing and publishing industrial category is composed of between 20,000-40,000 indirect discharging facilities. These facilities are currently exempt from regulation by categorical standards. As such, the total quantities of hazardous wastes generated and possibly discharged to POTWs by the entire industrial category would be expected to be large unless they are regulated by local pretreatment programs. Alternatively, it could be expected that the total amount of hazardous wastes discharged by each printing and publishing facility within the category would be relatively small and would probably not impact the POTW receiving the discharges. This scenario is somewhat supported by the findings in the SQG Survey (see Table 3-19), whereby the printing and publishing industrial category accounts for the largest quantity of hazardous waste discharged to POTWs by the SQGs within selected consent decree industrial categories (9,187,166 kg/yr). However, the amount of hazardous wastes discharged by individual facilities within the printing and publishing industrial category is one of the lowest of all the selected consent decree industrial categories (640 kg/yr/facility).

Data provided in Appendix K shows that the amount of hazardous waste discharged by individual printing and publishing facilities can affect POTWs. Appendix K provides several examples of incidents where printing and publishing facilities have discharged solvents causing potential upsets of POTW treatment systems and potential explosion situations at POTWs. The Paragraph 4(c) study (see Table 3-21) also presents documentation that 10 hazardous constituents (nonpriority pollutants) were detected in wastewaters from printing and publishing facilities. In particular, the following hazardous organics were found: acetone, ethyl ether, methyl ethyl ketone, and xylene. Quantities for hazardous nonpriority pollutant parameters could not be calculated for this industrial category.

3.3.5.4 Electrical and Electronics Components

The electrical and electronics components industrial category is composed of approximately 270 indirect dischargers, according to Table 3-12. The SQG segment of this industrial category, according to the SQG survey summary shown in Table 3-19, averages a discharge per facility of 11,440 kg/yr of hazardous wastes to POTWs, the largest of the selected consent decree industrial categories. The hazardous wastes described in the SQG survey for the SQGs within the electrical and electronic components industrial category are composed of strong acid or alkaline wastes and spent plating wastes.

Facilities in the electrical and electronic components industrial category also were involved in several incidents resulting in potential explosions at POTWs. These incidents occurred due to the discharge of solvents utilized in manufacturing processes at electrical and electronic components facilities. Hazardous priority organics discharges are regulated as total toxic organics under categorical pretreatment standards for the electrical and electronic components industrial category. However, the use and subsequent discharge of other hazardous constitutents (nonpriority organics) still may be of concern according to data presented in the Paragraph 4(c) study and the HWDMS data bases. Of the selected consent decree industrial categories, the electrical and electronic components category had the fourth highest number of nonpriority pollutants detected in the Paragraph 4(c) study. Of these nonpriority pollutants, the following hazardous organics were detected: acetone, methyl ethyl ketone, methyl isobutyl ketone, and xylene. The following hazardous wastes also were identified in the HWDMS for electrical and electronic components industrial category: acetone (U002), methyl isobutyl ketone (U161), and xylene (U239).

3.3.5.5 Industrial and Commercial Laundries

The industrial and commercial laundries industrial category, estimated by ITD to have over 68,000 facilities, has been exempted from regulation under categorical pretreatment standards. Due primarily to the diversity of services and operations found throughout the category, any of the hazardous constituents could be expected to be present in wastewater discharges to POTWs. The industrial and commercial laundries category ranks fifth of the selected consent decree categories in total hazardous constituent loadings (priority pollutant only) to POTWs after the implementation of pretreatment standards (1,486,000 kg/yr discharged). This category also ranks second out of the selected consent decree industrial categories in hazardous wastes discharged by SQGs to POTWs according to the SQG Survey shown in Table 3-19. The SQG survey attributes almost all of the hazardous wastes discharged to POTWs from the industrial and commercial laundries category to filtration residues from dry cleaning. These residues probably contain several hazardous constituents, including tetrachloroethylene and various petroleum solvents.

Results from the AMSA survey (Appendix K) found that 16 out of the 66 POTWs responding considered industrial and commercial laundries as "problem industries." As a result of the EPA sampling program initiated for this study (see Appendix J), several priority and nonpriority hazardous constituents were detected in indirect discharges from an industrial laundry. Following is a summary of the sampling results:

Hazardous Organic Constituent	Concentration (ug/l)
Acetone	1,542
Bis (2-Ethylhexyl) Phthalate	1,192
N-Alkanes (C_{10}-C_{20})	1,095
Isophorone	690
Toluene	548
1,1,1 Trichloroethane	478
Methyl Ethyl Ketone	427

Because the industrial and commercial laundries category is not regulated under categorical standards, the wastewater discharge practices are not expected to change unless there is a change in regulatory status or local limits are implemented at the POTW level.

3.3.5.6 Equipment Manufacture and Assembly

The equipment manufacture and assembly industrial category consists of those facilities that generally fall into SIC code groups 34-38 (except electroplating/metal finishing facilities). Estimates from OSW and OW for the number of indirect dischargers within the category range from approximately 30,000-100,000. Facilities within this category (also referred to by ITD as mechanical products manufacture) have been exempt from regulation under categorical pretreatment standards. Of particular concern to this study is the widespread use of degreasing solvents by equipment manufacture and assembly facilities. Loadings for several of the solvents most used in this category were estimated based upon data in the Electroplating/Metal Finishing Development Document;(9) end use production data for these solvents from the Chemical Economics Handbook,(10) and an estimate of 60,000 equipment manufacture and assembly facilities. These estimates are as follows:

Hazardous Constituent (Priority Organic)	Loading to POTWs (kg/yr)
Benzene	152,773
Methylene Chloride	534,706
Tetrachloroethylene	1,298,572
Toluene	229,160
1,1,1-Trichloroethane	3,819,331
Trichloroethylene	1,680,505

Based upon estimates for only the six solvents shown above and the fact that there are no categorical pretreatment standards, the equipment manufacture and assembly category ranks first in terms of total hazardous constituent loadings (priority only) for the selected consent decree industrial categories after the implementation of pretreatment standards (see Table 3-16).

According to the Paragraph 4(c) study, several hazardous constituents (nonpriority) also were detected in wastewater discharges from equipment manufacture and assembly facilities. These hazardous constituents included acetone, cresols, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, and xylene. The equipment manufacture and assembly category also ranked first in terms of the number of hazardous wastes identified in the HWDMS data base (see Appendix H) for the selected consent decree industrial categories. The diversity of hazardous wastes associated with this category, according to HWDMS, were expected due to the numerous products manufactured. The equipment manufacture and assembly category ranked second out of the selected consent decree industrial categories in terms of total hazardous waste discharges to POTWs from SQGs according to the SQG Survey (see Table 3-19). The hazardous wastes identified in the SQG Survey as being discharged by SQGs within this category were predominantly strong acid or alkaline wastes and spent plating wastes. Again, due to lack of regulation by categorical pretreatment standards, the characteristics of hazardous waste and constituent discharges within this industrial category are not expected to change unless limits are imposed at the local level.

3.3.5.7 Paint Manufacture and Formulation

According to the OW and OSW data bases reviewed for this study, the paint manufacture and formulation industrial category does not account for the discharge of large quantities of hazardous wastes or constituents to POTWs. However, according to data in Appendix K, discharges from paint manufacture and formulation facilities caused upsets of POTW biological treatment systems and affected receiving stream water quality. The hazardous constituents found in these discharges included solvents, toluene, and aniline.

As an example, a specific incident involving the discharge of hazardous constituents by a paint manufacture and formulation facility to a POTW resulted in potential explosion conditions throughout the POTW's collection system.(11) Samples of the effluent taken by the POTW from the facility found several hazardous constituents in high concentrations including toluene (105,460 ug/l), ethyl benzene (329,342 ug/l), benzene (237 ug/l), and xylene (654,420 ug/l). High concentrations of hazardous constituents also were found by the POTW at a pump station several miles downstream from the facility, including toluene (393 ug/l), ethyl benzene (843 ug/l), and xylene (42,599 ug/l). Further, high concentrations of these hazardous constituents were found at the POTW headworks and included toluene (71 ug/l), ethyl benzene (270 ug/l), and xylene (1,222 ug/l).

Analysis of other State and local data provided in Appendix I for the paint manufacture and formulation industrial category also show high average and maximum concentrations of various hazardous constituents, including acetone, carbon tetrachloride, ethyl benzene, methanol, methylene chloride, N-butyl alcohol, phenol, and toluene. Of particular interest in the State and local data is the fact that the average flow from paint manufacture and formulation facilities is 42,600 gallons per day. Although this average flow is substantially higher than the average estimated by ITD (1,000 gallons per day), it may represent nonprocess as well as process flow.

The paint manufacture and formulation industrial category ranked second in terms of total number of hazardous constituents (nonpriority) detected in the Paragraph 4(c) study. Several hazardous constituents (nonpriority) detected include acetone, N-butyl alcohol, cresols, ethyl ether, methyl ethyl ketone, methyl isobutyl ketone, and xylene. Finally, the paint manufacturing facility sampled by EPA for this study (see Appendix J) was found to be discharging several hazardous constituents to a POTW in significant quantities. Table 3-23 provides a summary of hazardous constituent concentrations in both the raw and treated (onsite treatment before discharge to POTW) wastewaters from this paint manufacturing facility. In summary, it appears that facilities within the paint manufacture and formulation industrial category have the potential to discharge significant quantities of hazardous constituents (both priority and nonpriority) to POTWs. This is due primarily to the lack of regulation by categorical pretreatment standards and the batch discharge characteristics found at paint manufacturing and formulation facilities.

3.3.5.8 Rubber Manufacturing and Processing

Although limited hazardous waste or constituent data exist, the rubber manufacturing and processing industrial category may be of concern regarding hazardous waste or constituent discharges to POTWs. This concern is due primarily to the nature of the manufacturing processes utilized. According to the Paragraph 4(c) data base (Table 3-21) and the HWDMS data base (Appendix H), the hazardous constituents that would be expected to be present in process wastewaters from rubber manufacture and processing facilities include degreasing and chemical formulation solvents (such as toluene [U220], 1,1,1-trichloroethane [U226], tetrachloroethylene [U210], and xylene [U239]). According to ITD estimates, there are approximately 500 indirect discharging facilities in the rubber manufacturing and processing industrial category. These facilities also have been exempt from regulation under categorical pretreatment standards. Data from the SQG Survey (Table 3-19) indicate that few of the indirect discharging rubber manufacturing and processing facilities are SQGs of hazardous wastes.

3.3.5.9 Coal, Oil, and Petroleum Products and Refining

The coal, oil, and petroleum products and refining industrial category may be responsible for the discharge of significant quantities of hazardous wastes and constituents to POTWs. Based on data presented in Appendix G and

TABLE 3-23. SUMMARY OF DSS SAMPLING AT AN INDIRECT DISCHARGING PAINT MANUFACTURING FACILITY

Hazardous Constituent	Raw Wastewater Concentrations (ug/l)	Treated Wastewater Concentrations* (ug/l)
Metals		
Antimony	<10	16
Arsenic	58	<5
Barium	1,260	253
Cadmium	30	<5
Chromium	4,620	3,100
Lead	122	<5
Organics		
Acetone	4,576	4,340
Ethylbenzene	2,183	1,237
Methylene Chloride	481,612	366,752
Phenol	1,818	1,472
Styrene	2,329	1,608
Toluene	621	352
Methyl Ethyl Ketone	119,736	106,502

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*Prior to discharge to POTW

Table 3-16, the petroleum refining segment of the coal, oil, and petroleum products and refining industrial category ranks third highest in terms of total hazardous constituents (priority pollutant only) loadings to POTWs (2,171,000 kkg/yr). Facilities within the petroleum refining segment of this category are only regulated for several conventional and nonconventional pollutant parameters by categorical pretreatment standards. These regulated parameters include oil and grease and ammonia. Although some incidental removal may occur, no substantial reduction of the hazardous constituents found in Table 3-16 would be expected as a result of the implementation of categorical pretreatment standards by the petroleum refining industry.

In an attempt to estimate hazardous waste generation for this category, nonconfidential RCRA 3007 Questionnaires submitted to and made available by OSW were reviewed. Based on the review of these questionnaires (a total of 71 out of 171 facilities), it was estimated that 2,002,645 metric tons of hazardous wastes are generated per year, of which 32,458 metric tons per year, or approximately 2 percent of the total, are discharged to POTWs. The above estimate is only for the petroleum refining segment of the coal, oil, and petroleum products and refining industrial category.

3.4 ANALYSIS OF OTHER POTENTIAL SOURCES OF HAZARDOUS WASTE DISCHARGES TO POTWS

3.4.1 Overview and Description of the Data Sources

The previous section of this Chapter (Section 3.3) presented estimates of the types and quantities of hazardous wastes discharged to POTWs by selected consent decree industries. This section presents information on hazardous waste discharges from other potential industrial sources. These sources have been grouped into the following industrial categories:

- Construction Industry
- Cosmetics, Fragrances, Flavors, and Food Additives
- Electrical Generating Power Plants and Electrical Distribution Services
- Service Related Industries
- Soaps and Detergents, Cleaning Preparations, and Waxes Manufacture and Formulation
- Stone, Clay, Glass, Concrete, and Other Mineral Products

- Fertilizer Manufacture
- Food and Food By-Products Processing
- Hazardous Waste Site Cleanup
- Laboratories and Hospitals
- Miscellaneous Chemical Formulations
- Motor Vehicle Services
- Transportation Services
- Waste Reclamation Services
- Waste Treatment and Disposal Facilities
- Wholesale and Retail Trade
- Wood Furniture Manufacture and Refinishing.

These categories are discussed separately because traditional EPA/OW and EPA/OSW data bases do not contain the types of information (i.e., number of indirect dischargers, average pollutant concentrations in process wastewater, etc.) necessary to estimate, at the National level, the quantities of hazardous waste discharged to POTWs by these industrial categories. Many of these categories also do not fall within the scope of the 1976 NRDC consent decree either because they are relatively new industries that have emerged since negotiation of the consent decree (e.g., waste reclamation sources, waste treatment and disposal facilities, etc.) or because they traditionally have been considered less significant waste sources due to their smaller size and service-related orientation (e.g., motor vehicle services, service-related industries, laboratories and hospitals, etc.). As a result, most of these industrial categories never have been extensively reviewed, for regulatory purposes, at the National level.

Due to the lack of comprehensive discharge data, Section 3.4 utilizes an eclectic approach, relying on a variety of data sources to develop a composite picture of each industrial category. These data sources include:

- Dun's Marketing Services - which provide estimates of the number of facilities encompassed by specific SIC codes.(12) (See Appendix L for a complete listing of data for applicable industrial categories.)
- SQG Data Base - which provides estimates for types and quantities of hazardous waste generated and discharged to POTWs by SQGs within specific industrial categories.(5) (See Table 3-24 for data on these categories.)
- AMSA Survey Data - which enumerates numbers and types of industrial facilities that are adversely affecting POTW operations. (See Appendix K for a complete description of survey data.)

- HWDMS Data Base - which provides information on the types of characteristic and listed wastes for facilities that treat, store, or dispose hazardous wastes. (See Appendix M.)
- POTW Incident File - which provides more detailed information on POTW incidents relating to the discharge of hazardous waste. Incident file data were collected as a followup to the AMSA survey and to other State/local contacts made at an initial phase in the study. (See Appendix K for the entire POTW Incidents File.)
- Industrial Sampling Data - which includes industrial sampling data collected by State and local authorities for a limited number of facilities in each category. (See Appendix I for complete listing of industrial sampling data.)
- Specific Examples - which represent accounts taken from other data sources, such as technical journals, magazines, and newspapers.

The following industrial profiles compile data from these various data sources in an attempt to provide a qualitative estimate of the potential for discharge of hazardous wastes and constituents by these industries. This approach, which emphasizes qualitative rather than quantitative estimates, prevents comparison of these industrial categories with the selected consent decree industrial categories presented in Section 3.3, in terms of overall significance and quantities of hazardous wastes and constituents discharged to POTWs. Specifically, SQG estimates (shown in Table 3-24 and referred to throughout this section) describe hazardous waste loadings to POTWs from the SQG segment of a particular industrial category. Alternatively, Section 3.3 primarily describes the quantities of hazardous constituents discharged to POTWs for each of the selected consent decree industrial categories.

3.4.2 Industrial Category Profiles

In this section, each industrial category listed previously will be discussed in detail. Process operations for each category will be described, and potential hazardous waste discharges to POTWs will be identified and characterized.

3.4.2.1 Cosmetics, Fragrances, Flavors, and Food Additives

The cosmetics industry encompasses an extensive variety of manufacturing operations and commercial products. The list of subcategories presented in

TABLE 3-24. SMALL QUANTITY GENERATOR HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90 PERCENT OF WASTE QUANTITY FOR OTHER INDUSTRIAL CATEGORIES

INDUSTRIAL CATEGORY	WEIGHTED # OF FACILITIES DISCHARGING TO POTW	TOTAL QUANTITY HAZARDOUS WASTE DISCHARGED TO POTWS (kg/yr)	HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY	TYPICAL HAZARDOUS WASTE CONSTITUENTS
Construction Industry	1,076	242,088	Ignitable Wastes (90%)	Naphtha, Kerosene, Turpentine, Gasoline, Diesel Fuel
Cosmetics, Fragrances, etc.	33	69,960	Strong Acid or Alkaline Wastes (60%) Ignitable Wastes (30%)	Acetone, Ethyl Acetate
Electric Generating Power Plants	NA	NA		
Fertilizers	17	22,572	Strong Acid or Alkaline Wastes (100%)	Ammonia, Phosphoric Acid, Sulfuric Acid
Food & Food By-products	NA	NA		
Hazardous Waste Site Cleanup	NA	NA		
Laboratories and Hospitals	2,926	2,099,664	Spent Solvents (50%) Ignitable Wastes (20%) Strong Acid or Alkaline Wastes (15%) Other Reactive Wastes (15%)	Acetone; Methyl Ethyl Ketone; Methyl Isobutyl Ketone; Benzene; Toluene; Methylene Chloride; Methanol; Hydrochloric, sulfuric, nitric, and chromic acids; Caustic soda
Miscellaneous Chemical Formulators	80	188,316	Strong Acid or Alkaline Wastes (60%) Spent Sovlents (25%) Pesticide Washing and Rinsing Solution (10%)	Solvents (e.g., as listed for "Laboratories"), Pesticides, Chemical Intermediates/Feedstocks (e.g., chlorobenzene, nitrobenzene, aniline)
Motor Vehicle Services	3,587	1,318,860	Spent Solvents (90%) Strong Acid or Alkaline Wastes (10%)	Gasoline, Naphtha, Tetraethyl Lead, Sulfuric Acid
Service Related Industries	23,395	23,146,068	Photographic Wastes (35%) Waste Formaldehyde (35%) Solution or Sludges with Photosilver (20%)	Silver, Cyanide, Chromium, Formaldehyde, Phenol, Pesticides
Soaps and Detergents	209	621,168	Pesticide Washing and Rinsing Solution (50%) Strong Acid or Alkaline Wastes (40%)	Sodium hydroxide, Potassium hydroxide, Phenol, Cresols
Stone, Clay, Glass, etc.	0	0*		
Transportation Services	582	26,436	Spent Solvents (100%)	Gasoline, Diesel Fuel, Naphtha (from tank cleaning and hazardous waste hauling operations, almost any RCRA waste is possible)

TABLE 3-24. SMALL QUANTITY GENERATOR HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90 PERCENT OF WASTE QUANTITY FOR OTHER INDUSTRIAL CATEGORIES (Continued)

INDUSTRIAL CATEGORY	WEIGHTED # OF FACILITIES DISCHARGING TO POTW	TOTAL QUANTITY HAZARDOUS WASTE DISCHARGED TO POTWS (kg/yr)	HAZARDOUS WASTE TYPE(S) ACCOUNTING FOR 90% OF WASTE QUANTITY	TYPICAL HAZARDOUS WASTE CONSTITUENTS
Waste Reclamation Services	NA	NA		
Waste Treatment and Disposal	NA	NA		
Wholesale and Retail Trade	366	160,020	Ignitable Paint Wastes (25%) Photographic Wastes (20%) Spent Solvents (20%) Wastewater Wood Preservative (15%) Pesticide Washing and Rinsing Solution (15%)	Cresols, Toluene, Silver, Cyanide, Chromium, Pesticides, Naphtha, Turpentine, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Phthalate esters
Wood Furniture	200	399,696	Filtration Residue from Dry Cleaning (60%) Spent Solvents (40%)	Tetrachloroethylene, Methanol, Methylene Chloride, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Phthalate esters, Turpentine, Toluene

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*Zero discharge of wastes to POTWs

NA = No available data

Appendix C illustrates the diversity of this industry. According to Dun's Marketing Service, there may be as many as 2,500 cosmetics, fragrances, flavors, and/or food additives manufacturers located in the United States. Still, the SQG data base (Table 3-24) projects only 209 SQGs in the category, and only 33 SQGs that discharge their hazardous wastes to POTWs.

Table 3-24 indicates that the SQG segment of the cosmetics industry may discharge hazardous wastes that are strongly acid or alkaline (60 percent of all waste), or ignitable (30 percent). Constituents imparting the acid/alkaline characteristic can be expected to be strong acids and bases, such as sulfuric acid or caustic. The ignitable wastes consist of organic solvents and plasticizers used in cosmetics manufacture and formulation, including acetone, ethyl acetate, and toluene. Other hazardous solvents potentially discharged by cosmetics manufacturers have been identified in the HWDMS data base (Appendix M), and include solvents such as methyl ethyl ketone, methyl isobutyl ketone, and butanol. Nitrobenzene, a constituent in soaps and shoe polishes, also is listed. Appendix I presents State/local sampling data relating to the discharge of hazardous constituents by cosmetics, fragrances, flavors, and food additives industries. The most frequently identified pollutants in these discharges are metals such as chromium, copper, lead, nickel, and zinc (three occurrences each). Organic solvents (e.g., carbon tetrachloride, chloroform, tetrachloroethylene) and plasticizers (e.g., bis(2-ethylhexyl) phthalate, butyl benzyl phthalate) also are identified in Appendix I as being present in discharges from this industry.

3.4.2.2 Construction Industry

These industries are engaged in erecting houses and other buildings. Dun's Marketing Service indicates that as many as 500,000 firms may be covered by this category. The SQG data base (Table 3-24) estimates that 16,988 construction firms are SQGs and 1,076 firms, or approximately 6 percent of the total, discharge their hazardous waste to POTWs. These indirect dischargers discharge 242,088 kg/yr of hazardous waste, 90 percent of which is RCRA ignitable waste. Examples of hazardous wastes that might be discharged by construction firms include gasoline, diesel fuel, and various solvents, such as naphtha and turpentine (see Table 3-24). The construction industry also may be a source of paint waste discharges to POTWs. Paint wastes contain hazardous solvents such as toluene, methyl isobutyl ketone, methylene chloride, trichloroethylene, and acetone.

3.4.2.3 Electrical Power Plants and Power Distribution

This category includes facilities engaged in the generation and transmission of electric power, including fossil fuel and nuclear power plants. These plants typically do not discharge large volumes of wastewaters to POTWs. Most power plants are located adjacent to water bodies, and prefer to utilize direct discharge for wastewaters. A major wastewater source from electrical power plants is water from air emmission scrubber systems. This wastewater will have a low pH, due to the hydrolysis of nitrogen and sulfur oxides, which form the corresponding acids. Another source of wastewater would be primary (boiler) and secondary loop blowdowns. For fossil fuel plants, these wastewaters will be contaminated only with boiler water additives such as corrosion inhibitors, etc. For nuclear power plants, primary, and even secondary, loop wastewaters can contain radioactive materials, and special precautions regarding handling and disposal must be observed. Another possible wastewater source involves the regeneration of ion exchange columns used to purify incoming water.

According to Dun's Marketing Service, there may be as many as 3,150 power plants and electrical transmission facilities. The HWDMS database (Appendix M) lists hazardous wastes potentially discharged by these facilities. Of the eleven hazardous wastes generated and listed in the database, most are solvents used by electric power plants in relatively small amounts. Appendix I presents State/local data on the discharge of hazardous wastes by electric power plants. Only three heavy metals are identified, including lead, nickel, and zinc.

3.4.2.4 Fertilizer Manufacture

For the purpose of this report, fertilizer manufacture is interpreted broadly to include the manufacture and formulation of nitrogen chemicals, phosphorus chemicals, and sulfuric acid. According to Dun's Marketing Service, as many as 1,600 firms manufacture fertilizers. It is not known how many of these firms discharge process wastes to POTWs. Exclusive of boiler and cooling water blowdowns, wastewaters from manufacturing nitrogen chemicals generally originate from condensors and/or scrubbers. These raw wastewaters can be expected to contain elevated ammonia levels, and hence, elevated pH and alkalinity levels as well. Wastewaters from urea production can be expected to contain ammonium carbamate and biuret, both unusable by-products. Wastewater from manufacturing phosphorus chemicals is produced similarly from gas scrubbing. The pH of such wastewaters is between one and two, and the phosphate concentration (as phosphorus) can be as high as 5,000 mg/l.(13) These wastewaters periodically are purged and treated by lime addition prior to discharge. Wastewaters from producing ammonium phosphates are similarly from gas scrubbing. Depending on the purity of the raw materials, the wastewaters from this process may contain fluoride, but most likely not elevated levels. Elevated levels of ammonia and phosphates, however, will be present.

The HWDMS data base (Appendix M) indicates that many hazardous organic chemicals, principally solvents such as benzene, methyl ethyl ketone, or methyl isobutyl ketone, may be found in fertilizer manufacturing wastes. The SQG data base (Table 3-24), however, indicates that virtually all of the projected hazardous waste loadings to POTWs (22,572 kg/yr) from fertilizer industries consist of acid/alkaline wastes, resulting from ammonia and phosphoric/sulfuric/nitric acids. An examination of fertilizer manufacturing processes confirms that significant amounts of organic chemicals are not involved. Therefore, the pollutant loadings to POTWs of the organics listed in the HWDMS data base can be expected to be minor. Appendix I presents State/local data on the discharge of hazardous wastes by fertilizer manufacturing firms. The pollutants listed consist of eight heavy metals and cyanide identified in a single observation.

3.4.2.5 Food and Food By-Products Processing

This category includes the processing of meat, fish, vegetables, grain, and milk into edible and inedible products. However, processing these foods into edible products generally must take place without the use of hazardous chemicals, owing to the restriction that the products must be fit for human consumption. Hence, this section focuses on the manufacture of inedible products from foodstuffs. Dun's Marketing Service indicates that there may be more than 26,000 food and food by-products industries located nationwide, although it is not known how many are indirect dischargers. The HWDMS data base (Appendix M) identifies hazardous wastes that potentially are discharged by food and food by-products industries. Many of these wastes are solvents, including toluene, methyl ethyl ketone, methyl isobutyl ketone, and methylene chloride. Most of these solvents are used as extracting/leaching solvents.

Appendix I presents State/local sampling data relating to the discharge of hazardous waste constituents by food and food by-products industries. Only heavy metals (and cyanide) are listed in discharges by these firms. The most frequently identified metals include copper (25 occurrences), zinc (24), and cadmium (23). Additional data for one large food processing facility located in New Jersey show approximately 12,000 kilograms of methylene chloride being discharged over a 1-year period.(14) According to Appendix K, a POTW in Ohio has reported corrosion problems owing to acid wastes discharged by a food processing firm. Remedial actions and enforcement actions have been taken to resolve this matter. Also, a hexane discharge by a food processing facility to a POTW located in Kentucky resulted in an explosion and serious damage to the POTW collection system.(15)

3.4.2.6 Hazardous Waste Site Cleanup

Hazardous waste site cleanup obviously does not fit into the classical definition of industrial category. Still, hazardous waste site cleanup can be a significant source of hazardous wastes and pollutants, particularly in recent years with the passage of CERCLA (Superfund) and the implementation of Federal, State, local, and private cleanups.

EPA estimates that there are almost 21,000 hazardous waste sites (including Federal, State, and local) that are being cleaned up or that will require cleanup.(16) This number does not include many minor cleanups initiated by companies still operating (such as a local service station that has had some gasoline leakage from its tanks). It is unknown how many of these cleanups have involved or will involve discharging hazardous wastes to a POTW. However, an EPA source(17) estimated that approximately 10 percent of the National priority list (NPL) Superfund sites ultimately will truck cleanup wastes to POTWs. If it is assumed that 2,000 of these NPL sites will require off-site disposal of their wastes, then approximately 200 sites can be expected to utilize POTWs for disposing their cleanup wastes.

Hazardous waste site cleanups consist of: (1) removing hazardous waste or hazardous constituents from the site and decontaminating the site, or (2) containing the hazardous waste and preventing migration of the wastes from the site. The types of sites involved include facilities that stored or treated hazardous wastes in containers, tanks, or surface impoundments, or disposed wastes in landfills or by other land disposal methods. Cleanups also can include sites where the contents of underground tanks or buried hazardous waste containers have leaked into adjacent soil, resulting in ground-water contamination. Currently, one of the more common site cleanups involves gasoline stations where underground gasoline tanks frequently leak due to corrosion. The leaking gasoline contaminates the surrounding ground water, resulting in contamination of drinking water supplies, surface waters, and/or infiltration into POTW collection systems.

Types and sources of wastewaters resulting from site cleanups that may be treated by a POTW include the following:

- Leachate from landfills
- Contaminated ground water from ground-water cleanups
- Aqueous wastes stored in containers, tanks, and surface impoundments
- Treatment sludges from remedial treatment systems at cleanup sites
- Stormwater runoff from contaminated soils
- Wastes from decontamination of containers, tanks, equipment, buildings, pavement and surrounding areas.

Wastes from site cleanups may be discharged directly to the POTW, discharged by separate pipe to the POTW, or hauled by truck or rail to the POTW.

Appendix I presents State/local data regarding hazardous waste discharges to POTWs as a result of hazardous waste site cleanup activities. Although the data are very limited, the pollutants and concentrations shown are significant. The organic chemicals listed in Appendix I for this category include chlorinated derivatives of ethane and ethylene, which are used widely as solvents for degreasing and other applications, and chlorinated derivatives of benzene, which are used widely both as chemical intermediates and as solvents. Various heavy metals also are listed for this category. The hazardous constituents listed most frequently are chromium (5 occurrences), and o-, m-, and p-dichlorobenzene (2 occurrences each). The hazardous constituents with the highest average discharge concentrations are chromium (1758 mg/l), bis(2-chloroethyl)ether (210 mg/l), chloroform (200 mg/l), toluene (22.4 mg/l), tetrachlorobenzene (11.7 mg/l), and 1,2,4-trichlorobenzene (11.7 mg/l).

Only one incident related to a hazardous waste site cleanup was identified during the investigation of incidents at POTWs. A POTW reported that gasoline or gasoline contaminated water had been discharged from a site contaminated with gasoline. In addition, Table 3-25 presents data for seven hazardous waste cleanup sites where wastewaters were discharged to POTWs. The data are taken from a March 1984 EPA report entitled Summary Report: Remedial Response at Hazardous Waste Sites, which provides case studies for a variety of hazardous waste site cleanups.(18)

3.4.2.7 Laboratories and Hospitals

Dun's Marketing Service data indicate that there may be as many as 30,000 hospitals and research, college, and medical laboratories in the United States. The SQG data base (Table 3-24) estimates that 5,643 hospitals and laboratories are SQGs, and that 2,926, or approximately 52 percent of the total, discharge their hazardous wastes to POTWs. According to Table 3-24, these 2,926 hospitals and laboratories discharge over 2 million kilograms per year of hazardous wastes, including spent solvents (50 percent of all waste), ignitable wastes (20 percent), strong acid or alkaline wastes (15 percent) and other reactive wastes (15 percent). Common laboratory solvents include the following hazardous materials: acetone, methyl ethyl ketone, methyl isobutyl ketone, benzene, toluene, methylene chloride, and methanol. Strong acids/

TABLE 3-25. DATA FOR HAZARDOUS WASTE CLEANUP SITES WHERE WASTES WERE DISCHARGED TO POTWs

Site Name/Location	Type of Incident	Type and Quantity Waste Discharged to POTW	Waste Constituents [Maximum Concentrations]
Howe, Inc. Brooklyn Center, MN	Fire in pesticides warehouse; runoff from fire; contaminated soil and ground water	Surface water: 2.1 x 10^6 gal. (8 x 10^6 l) Groundwater: 90 x 10^6 gal. (340 x 10^6 l)	Approximately 100 different pesticides and herbicides [only sampling data in report was for ice from runoff which showed a maximum of 5,200 mg/l of atrazine]
Anonymous Site C Depere, WI	Spills/dumps of chromic acid on ground contaminated soils and ground water	Groundwater from runoff: 72,000 gal. (273,600 l) in 1981, continued in 1982 and possibly thereafter	Hexavalent chromium [1,440 mg/l to 4,300 mg/l] Total Chromium [1,511 mg/l]
Chemical Recovery Systems, Inc. Romulus, MI	Leakage and dumping of still bottom wastes contaminating soil and ground water	Groundwater: 700-4,000 gpd (2,600-15,152 lpd) for unknown period	Chloroform [200 mg/l] Phenol [18 mg/l]
College Point Site Queens, NY	PCB contaminated oil dumped into lagoon	Lagoon water: 318,000 gal (1.2 x 10^6 l)	PCB contaminated water pretreated to lower O&G to <30 mg/l [concentrations of PCB in water unknown but PCB concentration in oil reached 240 mg/l]
General Electric Oakland, CA	PCB contaminated soils at site from spills/dumps off PCB oils	Groundwater: 1,000-1,500 gal. (3,800-5,700 l) per month for unknown period	PCB contaminated groundwater pretreated by oil water separation to an average of 0.1 ppb PCBs.
N.W. Mauthe, Inc. Appleton, WI	Soil and groundwater contamination from plating waste leakage from plating shop	Surface water, runoff, and groundwater: 273,000 gal (1.03 x 10^6 l) from April to December 1982. Unknown how long discharges continued after 12/82.	Hexavalent chromium primarily [230-420 mg/l]
Quanta Resources Queens, NY	Abandoned waste oil recycling facility with about 500,000 gallons of wastes	Hazardous and nonhazardous water from the site: 166,469 gal. (630,085 l)	Pretreated wastewater (pretreatment consisted of oil/water separation, physical/chemical treatment and filtration) [No effluent analyses reported, but had to meet NYC Industrial Discharge Criteria]

bases used frequently in laboratories include caustic soda, hydrochloric acid, sulfuric acid, nitric acid, and chromic acid. Broken thermometers or spilled barometer reservoirs can result in mercury discharges to POTWs from laboratories.

Inasmuch as most hospitals contain a laboratory, the wastes cited above also are generated by hospitals. In addition to these wastes, phenol and cresol-based disinfectants often are used by hospitals and may be discharged to POTWs. Hospital anesthetics include chloroform and diethyl ether, which may be discharged to POTWs in small amounts. Moreover, some RCRA-listed hazardous waste constituents reported by hospitals in the HWDMS data base are drugs, including chloroambucil, daunomycin, methylthiouracil, and mitomycin C. Hospitals also employ x ray film developing processes that generate wastewater contaminated with silver. However, some facilities have installed silver recovery units to reduce silver discharges from these operations.

Appendix I presents State/local data on the discharge of hazardous pollutants by laboratories and hospitals. The sampling data include numerous heavy metals, solvents, and disinfecting compounds. The metals most frequently identified are silver (67 occurrences), zinc (54), and copper (53). The pollutants with the highest average discharge concentrations are toluene (70 mg/l) and 1,2-dichloroethane (31 mg/l). Other significant pollutants detected include toluene, 1,2-dichloroethane, methylene chloride, phenol, and cyanide. One known POTW incident resulted from wastewater discharged from a research laboratory (Appendix K). The POTW's wastewater treatment plant was out of service for 2 days as a result of a fire at the laboratory facility, which caused unknown chemicals to be discharged to the POTW's sewers. No followup action was identified by the POTW.

3.4.2.8 Miscellaneous Chemical Formulations

The miscellaneous chemical formulations category includes a broad variety of chemical processes that are not covered in other industrial categories, such as inorganic and organic chemicals, plastics, pesticides, etc. The SQG data base (Table 3-24) projects 565 generators and 80 indirect dischargers in this category. These 80 SQG facilities are estimated to discharge 188,316 kilograms of hazardous waste per year, including strong acid or alkaline wastes (60 percent of all wastes), spent solvents (25 percent), and pesticide washing and rinsing solutions (10 percent).

The HWDMS data base (Appendix M) lists hazardous wastes potentially discharged by the miscellaneous chemical industries of this category. Predominant waste types for this category are solvents such as methanol, methyl ethyl ketone, methyl isobutyl ketone, pyridine, acetone, and tetrachloroethylene. Appendix I presents State/local data on hazardous waste discharges to POTWs by miscellaneous chemical formulators. The pollutants cited consist principally of solvents (acetone, toluene, chloroform, etc.), solvent degreasing compounds (1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, etc.), plasticizers (phthalate esters), and metals. The pollutants most frequently identified in Appendix I are chromium, lead, copper, nickel, zinc (4 occurrences each), and cyanide (3 occurrences). The pollutants with the highest average discharge concentrations are acetone (2.9 mg/l), methanol (2.5 mg/l), and cyanide (0.76 mg/l).

3.4.2.9 Motor Vehicle Services

Motor vehicle services include car and truck repair, body shop and painting shop work, car washing, and service station products sale (gasoline, oil). According to Dun's Marketing Service, there are as many as 433,000 firms providing these services nationwide. The SQG Survey (Table 3-24) indicates that 191,901 motor vehicle operations are SQGs, while 3,587, or 2 percent of this total, are discharging wastewaters to POTWs. These 3,587 facilities are estimated to be discharging 1,318,860 kilograms per year of hazardous wastes, including solvents (90 percent of all wastes) and strong acid or alkaline wastes (10 percent).

Solvents used in small amounts at service stations for degreasing and cleaning include chlorinated solvents, such as methylene chloride, and petroleum products, such as kerosene and naphtha. Gasoline contains toxic substances such as benzene, toluene, and tetraethyl lead. Other chemicals used in significant amounts include diethyl ether, methanol, and sulfuric acid. Waste lead-acid battery solutions constitute a source of lead and sulfuric acid. Also, painting operations will generate waste solvents and paints. Paint wastes contain metal pigments, as well as ignitable organic solvents, such as toluene, xylene, and naphtha.

Appendices I and K present State/local data regarding hazardous waste discharges to POTWs by motor vehicle services industries. Appendix I cites heavy metals as hazardous pollutants commonly discharged by these industries. The most frequently identified pollutants, as well as the pollutants found to have the highest average concentrations, are zinc (73 occurrences, 775 mg/l), copper (73 occurrences, 125 mg/l), and lead (70 occurrences, 2,324 mg/l). These results largely reflect sampling efforts of a single POTW, which sampled several radiator shops and detected extremely high levels of these metals in process wastewaters discharged by these shops. The AMSA POTW survey data (Appendix K) show that 10 of the 66 POTWs surveyed reported that discharges from motor vehicle operations caused problems with the collection system or treatment plant. Many POTWs reported gasoline spills into their collection systems from service stations and other sources. These POTWs include Albuquerque, NM; Bergen County, NJ; Fort Worth, TX; Hartford, CT; Rochester, NY; and the Washington Suburban Sanitary Commission (WSSC), MD. In general, these incidents related to spills or leaking underground storage tanks. However, in one case, gasoline was inadvertently pumped from a tank truck into the public sewer rather than into an underground storage tank. The incidents cited above caused a variety of POTW problems, including plant upsets and explosions/fires (see Appendix K for details). As an example, an automobile repair facility in Massachusetts was found to be discharging high-flash naphtha (degreasing solvent), toluene, and xylene to the POTW.(19) Although no serious damage occurred as a result of the incident, these discharge practices significantly increased risk of fire/explosion and adverse health impacts on POTW personnel.

3.4.2.10 Service-Related Industries

Firms within this category provide a wide variety of services to commercial clients and/or private citizens. Dun's Marketing Service estimates that as many as 1.16 million firms may be included in this category. Services with high potential for generating hazardous waste include agricultural services, photographic processing, warehousing, pesticide spraying, disinfection and extermination services, and funeral services.

The SQG Survey (Table 3-24) collected data on 1,716 facilities in this industry and estimated that there were 43,390 SQGs in the United States. Based on the SQG Survey, there are 23,395 facilities discharging to POTWs or approximately 53 percent of the industry. As estimated by the SQG Survey, these indirect dischargers account for over 23 million kilograms per year of hazardous waste discharged to sewers, averaging approximately 1,000 kilograms per year per facility.

According to Table 3-19, over half of the total hazardous waste discharged to POTWs by SQGs comes from service-related industries. The largest quantity of hazardous waste discharged from a single source within the service-related industrial category is waste formaldehyde from funeral parlors. Approximately 8 million kilograms a year from an estimated 12,000 facilities are discharged to the sewers. Photographic wastes containing cyanide and chromium either in spent chemical baths or in sludges precipitated out of these baths also account for approximately 8 million kilograms per year. An additional 4 million kilograms per year of solutions or sludges containing silver from photographic processing also are estimated to be discharged to sewers. Photofinishing laboratories and commercial photographers account for the majority of this waste. Other hazardous wastes discharged from SQG facilities within the service-related industry originate from the following sources:

- Approximately 600,000 kilograms per year of waste pesticide solutions from agricultural services and disinfecting and exterminating services (potentially containing pesticides and disinfectants such as aldicarb, lead arsenate, methoxychlor, disulfoton, 2,4-D, 2,4,5-T, pentachloronitrobenzene, pentachlorophenol, ethylene dichloride, 1,2-dibromo-3-chloropropane, cresols, and phenols)
- Approximately 500,000 kilograms per year of spent solvents from funeral parlors; photofinishing labs, and furniture refinishers (probably including basic solvents, such as benzene, toluene, 1,1,1-trichloroethane, and methylene chloride)

- Approximately 350,000 kilograms per year of reactive wastes containing ammonia from janitorial services
- Approximately 200,000 kilograms per year dry cleaning filtration residue probably containing tetrachloroethylene from furniture reupholsterers.

Appendix I presents State/local data on the discharges of hazardous wastes to POTWs by service-related firms, the majority of which were photoprocessing laboratories. The pollutants listed consist entirely of heavy metals and cyanide. Organics data generally are lacking since POTWs generally do not expend the resources to obtain organics data for service-related industries. The pollutants identified most frequently are silver (48 occurrences), copper (32), zinc (32), and nickel (29). The pollutants with the highest average discharge concentrations are cyanide (5.07 mg/l) and silver (3.85 mg/l). These data support the conclusion that photographic processing laboratories discharge a high level of metals and cyanide to the sewers. One POTW has indicated that collection system corrosion problems have occurred due to low pH discharges (as low as three) by a photofinishing facility (see Appendix K).

3.4.2.11 Soaps and Detergents, Cleaning Preparations, and Waxes Manufacture and Formulation

According to Dun's Marketing Service, as many as 3,600 firms manufacture soaps, detergents, cleaning preparations/waxes. The SQG data base (Table 3-24) projects 602 SQGs overall, and 209 SQGs, or 35 percent of the total, discharging wastes to POTWs. These wastes consist largely of pesticide washing and rinsing solution (50 percent of all wastes discharged) and strong acid or alkaline wastes (40 percent). Wastewaters from soap manufacture consist mainly of tank washouts and spills/ leaks. Wastewater sources in some cases also include barometric condensate, boiler blowdown, and intake water treatment. Raw wastes from soap manufacture are generally high in pH and alkalinity, due to the presence of caustic. Wastewaters from detergent manufacture also originate from tank washing, spills, and leaks, as well as from scrubbers. Wastewaters from detergent manufacture are generally low in pH and high in acidity, due to the presence of sulfuric acid.(20)

Wastewaters from the manufacture of cleaning preparations and waxes originate from a wide variety of chemical processes, and therefore defy simple characterization. Based on information contained in the HWDMS data base (Appendix M), constituents of wastewaters from the manufacture of cleaning preparations, waxes, soaps, and detergents may include the following hazardous compounds:

- Phenols and cresols (disinfectants)
- Methyl ethyl ketone, methyl isobutyl ketone, benzene, butanol, isobutanol, cyclohexane, toluene (solvents)
- Ethyl acetate (textile cleaning preparations)
- Nitrobenzene (soap, shoe polish additive).

Appendix I presents State/local data on the discharge of hazardous wastes by soap and detergent manufacturing industries to POTWs, and indicates that a wide variety of organic solvents, chemical additives, and metals are discharged by these industries. The most frequently detected pollutants for this category include nickel, zinc, chromium, copper (14 occurrences each), cadmium (13), antimony (12) and lead (12). The pollutant with the highest average concentration was xylene (275 mg/l).

3.4.2.12 Stone, Clay, Glass, Concrete, and Other Mineral Products

This category encompasses the extraction of mineral raw materials from the earth and their direct conversion into products. Typical industries in this category include glass manufacture, stone quarrying, processing of asbestos into textile products, and talc and gypsum manufacture. According to EPA's SQG Survey (Table 3-24), no hazardous wastes can be expected to be discharged to POTWs from industries within this category that generate less than 1,000 kg of hazardous waste per month. Within the glass manufacturing industry, only two manufacturers of flat glass and five manufacturers of automotive glass discharge any wastewaters to POTWs.(21) Hazardous waste quantities within these wastewaters can be considered negligible since the only nonconventional contaminants present result from oil and machine lubricant wash-in.

Appendix M delineates hazardous wastes types that typically are generated by industries within this category. Most of the specific chemical wastes cited for this industrial category consist of organic solvents (acetone, methylene chloride, toluene, etc.). These chemicals can be expected to be used in only minimal amounts by these industries. Appendix I presents State/local data regarding hazardous wastes discharged by industries within the stone, clay, glass, and other mineral products category. The hazardous constituents identified consist of organic solvents and plasticizers and heavy metals. The most frequently identified pollutants are chromium, cadmium, copper, lead, nickel, and zinc (5 occurrences each). The pollutants with the highest average concentrations are phenol (5.2 mg/l), zinc (5.0 mg/l), and nickel (2.0 mg/l).

3.4.2.13 Transportation Services

This category includes firms that maintain vehicles for transporting people, cargo, and municipal and industrial waste. Dun's Marketing Service indicates that as many as 150,000 firms perform these services. The following types of firms are included in this category:

- Ship maintenance
- Airport services
- Railroad car cleaning
- Tank truck cleaning (cartage firms)
- Municipal refuse hauling
- Septage hauling
- Drum reclamation
- Hazardous waste hauling
- Cargo handling facilities (terminals).

The 150,000 figure includes as many as 127,013 miscellaneous trucking and warehouse operations and an estimated 12,343 hazardous waste haulers.(22) However, facilities that typically generate and discharge significant quantities of wastes, such as tank truck cleaning, septage hauling, and drum reclamation services, are not included.

The EPA report, Investigation of New Industries, estimated that in 1978 there were 500 tank truck cleaning terminals and 400 drum cleaning facilities.(22) Using figures from the 1978 EPA report Source Assessment: Rail Tank Car, Tank Truck, and Drum Cleaning, State of the Art, the report indicated that wastewater discharges resulted from the cleaning of approximately 5,010,000 tank trucks and 14,580,000 drums per year.(23) Quantities of hazardous waste generated and discharged to POTWs by transportation service facilities are unknown. The SQG Survey estimated that 582 transportation service facilities discharge 26,436 kilograms per year of spent solvents to POTWs. In addition, a 1981 EPA study estimated that drum reconditioning firms generate approximately 74,000 metric tons (162 million lbs) of hazardous wastes per year.(24)

Liquid waste haulers represent an additional source of hazardous waste discharges to POTWs. Some of these discharges fall into the category of illegal or midnight dumping, while other discharges result from legal discharges by septage and liquid waste haulers to POTWs. The following incidents provide examples of midnight dumping:(25)

- In 1979 and 1980, a New Jersey waste hauler discharged an undetermined number of drums of hazardous waste into its warehouse's sewer
- Another New Jersey waste hauler discharged more than a quarter of a million gallons of toxic wastes and sludge into a POTW's sewer
- Also in New Jersey, a waste hauler trucked an estimated 3.2 million gallons of flammable wastes to the hauler's owner's facility and dumped these wastes into a POTW's sewers.

Review of hazardous waste-related incidents at POTWs (Appendix K) indicates that the following incidents have occurred at POTWs as a result of waste haulers:

POTW	INCIDENT
• Central Contra Costa, CA	Biological upset from solvents discharged by liquid waste hauler

POTW	INCIDENT
• Orange County, CA	Caustic discharged by liquid waste hauler
• Marysville, NJ	Biological upset from pentachlorophenol discharge; waste hauler suspected
• Encino, CA	Collection system explosion/ fire attributed to septic waste hauler's discharge
• San Diego, CA	Collection system explosion/ fire attributed to liquid waste hauler's discharge of gasoline.

In addition, several incidents were reported, but could not be traced to any source. It is probable that some of these incidents can be attributed to waste haulers. The AMSA POTW survey (Appendix K) indicates that 26 of 62 POTWs reported problems caused by midnight dumping. Additionally, 21 of these POTWs reported problems with liquid septage haulers and 15 reported problems with other liquid waste haulers.

It is estimated that 50-60 million storage drums were cleaned in 1984.(22) Many of these were cleaned by exposing the drums to high temperatures to burn off any residue, or cleaned with various cleaning agents, similar to those used in tank car cleaning discussed above. Hazardous wastes will be generated if the drum previously contained hazardous materials or if the cleaning agents used are hazardous (e.g., caustic or corrosive). After drums are cleaned, they may be repainted. Spray painting may occur in special paint booths that utilize water curtains which are also a potential source of hazardous waste discharges. Also, paint spills represent a potential source of hazardous wastes to POTWs. The following hazardous waste-related incidents caused by drum cleaning and reclamation facilities were reported by POTWs:(19)

- A drum cleaning company in Massachusetts was found to be discharging liquid chemical residues from barrels into the POTW's sewers. Untreated caustic wastewater from a barrel washing operation also was discharged to the sewers.

- An 8-acre drum cleaning and recycling plant in Texas was subjected to regulatory action for discharging wastes directly into the city sewer system.
- An Iowa metal drum recycling operation that has been the cause of chronic oil contamination of surface waters, as well as one onsite fire, has been discharging 58 tons of spent caustic wastes annually to the nearby POTW.

Further, sampling results of wastewater discharges from a drum reconditioning facility in New York indicated significant quantities of hazardous constituents.(26) In summary, the hazardous constituents found in high concentrations include: benzene (1,400 ug/l), ethyl benzene (1,400,000 ug/l and 286,000 ug/l), toluene (1,400,000 ug/l and 59,000 ug/l), phenol (6,830 mg/l and 566 mg/l), and napthalene (24,000 ug/l and 68,000 ug/l).

Hazardous wastes generated at ship cleaning facilities contain constituents of fresh paint such as chromium and lead pigments, and solvents such as toluene. Heavy metals also can leach from used paint chips scraped from hulls and discarded in a sewer. Spent strong acid or alkaline cleaning solutions also constitute hazardous wastes that may be discharged at ship cleaning facilities. Airports can generate hazardous wastes that include spilled aviation fuel and degreasing solvents. Vehicles used to transport chemical products, such as railroad tank cars and tank trucks, frequently are cleaned out with various cleaning agents. Typical cleaning agents used are steam, water, detergents, caustic or acid solutions, and solvents. The spent cleaning solutions could contain virtually any hazardous waste, depending on the chemicals most recently hauled. Spent solvents, however, appear to be the most significant hazardous constituents of these wastes. These spent cleaning solutions often are discharged to sewers with minimal pretreatment. Several waste related incidents involving a tank car cleaning facility have occurred in Cleveland, Ohio.(19) The tank car cleaning facility has a neutralization/reacting chlorine operation that has resulted in the deaths of two employees and numerous health-related incidents. The facility also has been illegally discharging its cleaning wastes to the Cleveland sewer system.

Another major source of hazardous waste dicharges to POTWs results from tank truck spills. Appendix K indicates that the following incidents have occurred at POTWs as a result of tank truck activities:

POTW	INCIDENT
Alberquerque, NM	gasoline spill washdowns
Anchorage, AK	gasoline spill washdowns
Indianapolis, IN	gasoline spill washdowns; one resulting in fire/explosion
Nashville, TN	gasoline spill washdowns
Rochester, NY	gasoline spill washdowns
St. Paul, MN	gasoline spill washdowns.

Cargo handling facilities and petroleum tank farms/terminals also represent potential sources of hazardous wastes. These wastes may be discharged to POTWs as a result of tank overflows, spills, etc. Generally, these wastes can be expected to consist of ignitable or toxic constituents such as benzene, toluene, kerosene, naphtha, turpentine, methyl isobutyl ketone, hexane, etc.

The HWDMS data base (Appendix M) indicates that almost any hazardous waste potentially could be discharged by facilities within this category. State and local data (Appendix I) indicate that cyanide and 10 toxic metals, as well as 24 organic compounds, were detected in significant amounts in discharges from facilities within this category. According to Appendix I, the most frequently identified hazardous constituents in discharges to POTWs by industries within this category were nickel (17 occurrences), zinc (17), lead (16), copper (16), chromium (15), and cadmium (13). The most frequently identified toxic organics were toluene (8), trichloroethylene (6), and 1,1,1-trichloroethane (5). The pollutant with the highest average discharge concentration identified is tetrachloroethylene (1.4 mg/l).

3.4.2.14 Waste Reclamation Services

The types of operations conducted at waste reclamation facilities are varied and consist of facilities that are engaged primarily in the collection and reclamation of scrap and waste materials. Waste reclamation operations generating significant quantities of wastes may include the following:

- Waste oil reclamation by filtration, water separation, or other method for reuse, or by incineration for heat recovery
- Waste solvent reclamation by distillation, filtration, or other method for reuse, or by incineration for heat recovery
- Acid regeneration
- Metal recovery from sludges
- Battery salvage.

Appendix L shows the subcategories of waste reclamation service facilities. The only subcategory for which the number of facilities could be identified was metals reclamation with as many as 9,450 facilities.

The SQG Survey did not report on waste reclamation facilities. Very little data are available on the numbers of waste reclamation facilities that generate hazardous waste or on the number of these facilities that discharge wastes to POTWs. However, information from studies covering various segments of the waste reclamation industry provides a profile of types and quantities of wastes generated and potentially discharged by these facilities. In an EPA report, Investigation of New Industries, SAIC estimated the number of solvent reclaimers to be between 225 and 300.(22) The quantity of solvents reclaimed in 1981 was estimated to be over 100 million gallons, with the quantity expected to increase substantially over time. A report done by the California Hazardous Waste Management Project (February 1983) showed that in Los Angeles County alone there were three solvent recyclers with a combined capacity of 5.85 million gallons per year.(27) Waste oil recyclers are another large source of hazardous waste. From the above-referenced California report, nine waste oil recycling firms were identified in Los Angeles County alone. These nine facilities recover 18 million gallons of used oil annually.

Most waste reclamation operations generate wastes from removal of contaminants from the waste being reclaimed. The resulting purified product then can be reused or burned for heat recovery. The types of wastes generated and their corresponding sources include the following:

- Oily aqueous wastes from oil/water separation
- Sludges containing metals, oil, grit, or other contaminants from oil filtration and purification operations
- Sludges containing metals, grit, solvents, or other contaminants from solvent distillation processes
- Sludges containing metals, oil, grit, hydroxide compounds, or other contaminants from acid regeneration and metal recovery operations
- PCB-contaminated waste oils and sludges from the reclamation of electrical transformer and capacitor dielectric fluids
- Acid or acid-neutralized wastes containing metals from battery salvage operations.

Waste reclamation facilities are also prone to spills and leaks of the wastes being reclaimed, the purified products, and the wastes generated by the reclamation operations. Waste reclamation facilities also have caused problems with soil and ground-water contamination and, in many cases, have eventually become hazardous waste cleanup sites. Some of these so-called waste reclamation facilities were nothing more than indefinite waste storage facilities that eventually closed, leaving the accumulated wastes behind.

The HWDMS data base (Appendix M) indicates that waste reclamation facilities reported to EPA that they generate wastes considered EP toxic for each of the RCRA-listed metals, as well as spent solvents, acids, plating and cleaning baths, still bottoms, and oil sludges. Appendix I presents State/local data concerning hazardous waste discharges to POTWs by waste reclamation industries. Although data are limited, 32 toxic organic compounds, 6 metals, and cyanide were detected at these sites. A variety of organic chemicals are listed, such as toluene (utilized in fuels and as a solvent, especially in paints), ethylbenzene (chemical intermediate for styrene manufacture and used as a solvent), chlorobenzene (chemical intermediate and used as a solvent) and chlorinated ethanes and ethylenes (used as solvents, especially in degreasing). The most frequently identified pollutants listed in Appendix I are toluene (45 occurrences), 1,1,1-trichloroethane (36), methylene chloride (30), tetrachloroethylene (27), trichloroethylene (25), and ethyl benzene (24). The pollutants with the highest average concentrations are ethyl benzene (250 mg/l), xylene (170 mg/l) bromoform (83 mg/l), 1,1,1-trichloroethane (37 mg/l), and tetrachloroethylene (21 mg/l).

Discharge data were collected for an indirect discharging solvent recovery facility as a result of the EPA sampling program initiated for this study (see Appendix J). The results of the sampling program for this facility (sampled over a 1-day period) found several hazardous organic constituents in high concentrations. A summary of the data collected for this solvent recovery facility is as follows:

Hazardous Organic Constituent	Concentration (ug/l)
Acetone	415,110
Benzene	26,130
Methylene Chloride	5,319
Toluene	438
Trichloroethane	352
1,1,2-Trichloroethane	2,090
1,1,2,2-Tetrachloroethane	2,090

As the above data reveal, raw wastestreams from solvent recovery facilities can be expected to contain common industrial organic solvents. The exact composition and concentration profile of each wastestream would depend upon the nature and composition of the waste solvent being reclaimed.

The AMSA POTW survey (Appendix K) showed that a total of seven waste reclamation facilities were identified as problem industries. In a related incident, one POTW reported problems caused by a waste reclamation facility. A battery salvaging operation generated waste acids that were "midnight dumped" over a period of 3 to 4 years. As a result of these discharges, sections of sewer pipe and pumps had to be replaced. The company was forced to shut down and halt its discharges.

3.4.2.15 Waste Treatment and Disposal Facilities

The types of facilities in this category can be split up into two major classes, including those that handle hazardous waste regulated under RCRA Subtitle C and those that handle solid, nonhazardous waste. The first class includes Subtitle C treatment, storage, and disposal facilities (TSDFs), which EPA has estimated to number 4,961 (See Appendix L). About 4,000 of these facilities are located at establishments that are classified as manufacturers. The RCRA TSDFs include facilities that store or treat hazardous waste in containers, tanks, surface impoundments, or wastepiles, or dispose hazardous waste in landfills, surface impoundments, or incinerators. Generators that store hazardous waste for less than 90 days or treat waste in tanks that are part of a wastewater treatment system regulated under the NPDES or pretreatment programs are not considered TSDFs under RCRA. The second major class covers Subtitle D municipal and industrial landfills and surface impoundments. A report developed by the Office of Technology Assessment estimated that there may be as many as 202,562 waste units that qualify as Subtitle D land disposal facilities.(28) A third, smaller class of waste treatment and disposal facilities includes centralized industrial waste treatment facilities. Many of these, however, are already included in the RCRA TSDF group.

Currently, there are no reliable estimates for the number of waste treatment and disposal facilities that are indirect dischargers. Generally, storage and land disposal facilities do not discharge wastes to POTWs. However, in certain cases where contaminated runoff or leachate is collected, the facility may truck these wastes to the POTW or discharge directly to the POTW if the facility is connected to the POTW's sewerage system. Treatment facilities and incineration facilities also may discharge wastes to POTWs. These wastes include the effluent from the treatment systems, contaminated runoff, and air pollution scrubber wastewater.

Wastes from waste treatment and disposal facilities may contain diverse constituents and can be expected to reflect the makeup of the wastes being treated at the facility. Landfills that accept many kinds of wastes, particularly municipal landfills, also can generate leachate contaminated with a variety of compounds. The HWDMS data base (Appendix M) shows the types of hazardous waste reportedly managed by RCRA TSDFs. As indicated, almost all characteristic and listed wastes regulated by RCRA have been reported as potentially present at these facilities. Data from this appendix support a conclusion that virtually any type of constituent may be present in wastes from TSDFs.

Appendix I presents State/local data relating to hazardous wastes discharged to POTWs by waste treatment and disposal facilities. Although the data are limited, 38 organic compounds, 10 metals, and cyanide have been detected in these effluents. A wide variety of organic compounds are listed, including chlorinated ethanes and ethylenes (solvents, especially for degreasing); chlorinated benzenes (solvents, chemical intermediates); phenol (chemical intermediates, disinfectants, resins); methyl ethyl ketone/methyl isobutyl ketone (paint solvents, paint removers); bis(2-ethylhexyl)phthalate (plasticizers); chloroform/methylene chloride (volatile solvent applications, including degreasing, paint removing), etc. The most frequently identified hazardous constituents listed in Appendix I, however, are generally metals, including nickel (55 occurrences), cyanide (54), copper (54), phenol (45), chromium (41), lead (38), cadmium (36), and zinc (35). The hazardous constituents with the highest average discharge concentrations are: chlorobenzene (6.3 mg/l), phenol (5.6 mg/l), tetrahydrofuran (5.5 mg/l), acetone (3.3 mg/l), and zinc (3.3 mg/l). As further indication of hazardous constituents discharged to POTWs, analytical data for the effluent from a waste treatment and disposal company in New Jersey were obtained and reviewed.(14) Data for monthly averages of total toxic volatile organic compounds ranged from a low of 0.32 ppm to 21.92 ppm for an 8-month period. The maximum single value for the period was 137.27 ppm of toxic volatile organics.

Three incidents at POTWs caused by waste treatment and disposal facilities were identified during the investigation of POTW incidents (Appendix K). In the first case, the discharge of hazardous constituents caused inhibition of treatment processes. In the second case, chlorinated organics were discharged, producing hazardous odors in the collection system, and forcing workers to leave the collection system. The offending company installed a new treatment system to alleviate this problem. In the third case, a hazardous waste treatment and recycling facility connected to a POTW and began discharging various wastes containing metals and solvents. These discharges resulted in worker illness from solvent fumes, and severe contamination of the POTW's sludge with metals discharged by the facility. When sewer use ordinance provisions were enacted by the POTW to remedy the problem, the company moved to another POTW's jurisdiction.

An EPA study, Investigation of New Industries,(22) and the AMSA POTW survey (Appendix K) show that the number of waste treatment and disposal facilities are increasing substantially. The AMSA POTW survey indicates that the number of requests for connection to POTWs by waste treatment and disposal facilities increased from 4 in 1981 to 13 in the first 6 months of 1985. Consequently, these types of facilities will become an increasing problem for POTWs, particularly since existing pretreatment controls, such as categorical standards, generally do not address wastewaters discharged by these facilities, and information generally is not available to control these facilities through the general prohibitions and local limits provisions in the General Pretreatment Regulations.

3.4.2.16 Wholesale and Retail Trade

Companies in this category are involved in selling industrial, commercial, and household products. Appendix L indicates that more than 22,500 firms are engaged in this business. The SQG data base (Table 3-24) projects 366 indirect discharges in this category out of a total number of 5,733 generators. These 366 facilities discharge an estimated 160,020 kilograms per year of different waste types, including ignitable paint wastes (25 percent of all waste), photographic wastes (20 percent), spent solvents (20 percent), wastewater wood preservatives (15 percent), and pesticide washing and rinsing solutions (15 percent). Activities within this broad category most likely to discharge hazardous wastes to sewers include sales of chemical products, petroleum products, and industrial supplies. Virtually any product sold by these firms potentially can be discharged to a POTW as a result of improper handling, spills, discards of off-spec or aged chemicals, etc. Commonly discharged hazardous wastes include volatile solvents in discarded paint products, cresols in discarded creosote wood preservatives, household and commercial pesticide products, and commonly used petroleum solvents and fuels such as naphtha, turpentine, or kerosene.

Appendix I presents State/local data on hazardous wastes discharged to POTWs by wholesale trade industries. The hazardous constituents listed consist of heavy metals, solvents, and plasticizers. The hazardous constituents most frequently identified are cadmium, copper, mercury, nickel, silver, and zinc. The hazardous constituents with the highest average discharge concentrations are zinc (0.68 mg/l), lead (0.40 mg/l), and arsenic (0.26 mg/l).

3.4.2.17 Wood Furniture Manufacture and Refinishing

Industries in this category produce furniture from wood and/or finish, refinish, clean, and paint new and used wood furniture. According to Dun's Marketing Service, there are as many as 31,000 of these firms nationwide. The SQG Survey (Table 3-24) shows 2,393 generators, of which only 200 are projected to be discharging to POTWs. The SQG Survey shows that these 200 facilities discharge almost 400,000 kg of hazardous waste per year, including filtration residue from dry cleaning (60 percent of all waste) and spent solvents (40 percent). Most of these wastes are spent solvents and residues from wood finishing, refinishing, cleaning, and painting operations.

Common solvents found in varnishes and paints applied to wood include acetone, methyl ethyl ketone, methyl isobutyl ketone, methanol, toluene, and methylene chloride. Polyurethane coatings, commonly used by wood furniture refinishers, contain toluene diisocyanate as a resin monomer. Paints generally contain plasticizers, such as dioctyl phthalate and bis(2-ethylhexyl) phthalate, to reduce paint cracking upon aging. Other hazardous constituents of paints include: various inorganic paint pigments, such as litharge (PbO), red lead ($Pb_2O_3 + PbO$), and emerald green ($Cr_2O(OH)_4$); asbestos and barite (barium sulfate), which often are incorporated into paints as extenders; and chlorinated phenols, which are added to latex paints as a paint preservative. Paint stripping solvents generally consist of flammable solvents, such as naphtha, turpentine, methyl ethyl ketone, toluene, methanol, or methylene chloride. Paint strippers also may contain phenols and cresols.

Another solvent, tetrachloroethylene, is used to dryclean upholstery and may be used in substantial quantities by refinishing firms for this purpose. Finally, creosote (cresols) may be added to some wood products as a preservative.

The HWDMS data base (Appendix M) describes hazardous wastes typically generated by wood furniture manufacturers and refinishers. These data support the conclusion that the principal hazardous wastes generated by these firms are volatile organic solvents from wood finishing and refinishing operations described above. Additional major varnish and shellac solvents, cited in the HWDMS data base, include ethyl ether, ethyl acetate, and cyclohexanone. Appendix I presents State/local data on hazardous wastes discharged to POTWs by wood furniture manufacturing, finishing, and refinishing firms. Although sampling data for these firms are limited, they do show some high concentrations of organic solvents and heavy metals. Lead (4 occurrences each) was identified most frequently. Two organic solvents, methanol and methylene chloride, possess the highest average discharge concentrations (5,065 mg/l and 1,474 mg/l, respectively). The AMSA survey data (Appendix K) show that, of seven POTWs that have sampling data for wood furniture manufacture and refinishing, two POTWs consider these facilities to be problem industries. In one incident in Pensacola, FL, discharge of paint stripper resulted in a biological upset of the POTW's treatment plant.

3.5 SOURCE EVALUATION OF HAZARDOUS CONSTITUENT LOADINGS TO POTW INFLUENT WASTEWATERS

Previous sections of Chapter 3 have examined industrial survey/sampling data to identify and characterize major sources of hazardous waste discharges to POTWs. This section projects and evaluates hazardous constituent loadings to POTW influent wastewaters, and describes possible industrial sources of hazardous constituents known or believed to be common in POTW influent wastewaters. Also, this section examines the possible correlation between chemical use rates and hazardous constituent loadings to POTWs, and utilizes this statistical relationship to project POTW influent loadings of selected nonpriority pollutants. The final portion of Section 3.5 provides production/use profiles for selected hazardous organic constituents.

3.5.1 Projected National Loadings of Priority Hazardous Constituents to POTWs

In 1978, EPA initiated a project to study the occurrence and fate of priority pollutants at 40 POTWs in the United States. This project, now referred to as the 40 POTW Study, included an extensive sampling program for all priority pollutants at 40 well-operated secondary treatment POTWs representing a variety of municipal treatment technologies, size ranges, and industrial flow contributions.(29) The project also emphasized the development of optimum POTW sampling methodologies and establishment of appropriate analytical protocols and field and laboratory Quality Assurance/Quality Control (QA/QC) procedures for use during the entire study.

In selecting the 40 POTWs for sampling, EPA considered the following factors:

- Treatment processes
- POTW size
- Amount of industrial contribution
- Type of industrial contribution
- POTW operating efficiency (i.e., meeting secondary treatment)
- Actual flow as a percent of design capacity
- Geographical distribution.

Overall, the POTW selection process incorporated a geographical and secondary treatment type distribution that approximately profiled POTWs over 5 mgd nationwide. The study evaluated at least one POTW from each EPA Region, and POTWs from 25 different States. The number of plants in each EPA Region was approximately proportional to the total number of POTWs over 5 mgd in that region.

Total flow for the 40 POTWs was 1,739 mgd, or approximately 6.8 percent of total POTW flow nationwide. The study focused primarily on POTWs greater than 5 mgd in flow since these plants treat most of the Nation's wastewater and are covered by the National pretreatment program. Industrial flow contributions to these plants ranged from 0 to 50 percent, although the Agency generally selected POTWs treating between 10 and 50 percent industrial wastewater flow. EPA selected POTWs accepting wastewater from a broad variety of industries, and from most of the industrial categories encompassed by the NRDC consent decree. The Agency attempted to select POTWs that were representative of the National distribution for POTW size and industrial flow percentages. Also, based on a comparison with industrial flow data from the EPA NEEDS data base, the 40 POTWs appear to be fairly representative of the mix of industrial flow percentages both for POTWs greater than 5 mgd in flow and for all POTWs in the United States.(30) Table 3-26 provides a comparison of industrial flow contributions for wastewaters received by these three POTW sets. Although not statistically representative of all POTW influent wastewaters in the United States, the 40 POTW sampling data nonetheless provides a rough profile of the types and quantities of priority hazardous constituents discharged to POTWs Nationally.

The 40 POTW sampling data are also more reliable than other POTW sampling data since they result from a project utilizing consistent and tested sampling methodologies, analytical protocols and QA/QC procedures. Moreover, because each POTW was sampled over a 6-day period, the 40 POTW data account more fully for daily variation in pollutant loadings to individual POTWs. By comparison, most other POTW priority pollutant sampling data result from 1-, 2-, or occasionally, 3-day sampling sequences at individual POTWs.

In evaluating the representativeness of the 40 POTW data, the two greatest concerns involve timing of the study and sample size. Because the actual sampling for the 40 POTW study was conducted over a time period from 1979 to 1981, the data may not accurately reflect current priority hazardous constituent loadings to POTWs. This concern is heightened somewhat in light of the significant regulatory changes (e.g., RCRA implementation, pretreatment implementation) that have occurred over the last 5 years. Also, sample size for the 40 POTW study may not adequately represent the range of hazardous constituent loadings, particularly organic constituent loadings, to POTWs across the United States. In examining both 40 POTW data and other POTW sampling data, it would appear that there may be extreme variations in organic constituent pollutant loadings depending on the size and type of industrial community contributing wastewater to a specific POTW. To meet this concern, 40 POTW data were scrutinized for the presence of sampling data that could severely skew National loadings projections. Alternative loading estimates presented in this study reflect the existence of these statistical outliers in the 40 POTW data base.

TABLE 3-26. COMPARISON OF INDUSTRIAL FLOW PERCENTAGES FOR 40 POTWS AND EPA NEEDS POTWS

% Industrial Contribution	40 POTW Flow (mgd)	% of Total 40 POTW Flow	NEEDS Flow for POTW >5 mgd (mgd)	% of Total NEEDS Flow for POTW >5 mgd	NEEDS Flow for all POTWs (mgd)	% of Total NEEDS POTW Flow
0-10	692	40	6994	35	11,803	44
11-30	842	48	8749	44	9901	37
>30	205	12	4001	20	4886	18

Table 3-27 provides estimates of National loadings for metals, cyanide, and selected organic priority constituents based on POTW sampling data contained in the 40 POTW study. As indicated in Table 3-27, two different methodologies have been used in developing estimates for organic priority constituent loadings. The first methodology utilizes flow-weighted average constituent pollutant concentrations for influent wastewaters from all 40 POTWs evaluated in the study. The second, and preferred, methodology utilizes flow-weighted averages, excluding organic priority constituent data from one POTW (POTW #28) considered to be a statistical outlier in terms of the quantities of certain organic priority constituents occurring in its influent wastewater. This POTW receives approximately 6 million pounds per year of organic priority constituents, an extreme value when compared with the other 39 POTWs evaluated in the 40 POTW study. Moreover, a review of ITD and ISDB organics industry data revealed that the POTW was one of the largest known receptors of process wastes from the organic chemicals and pesticide industries. Consequently, influent hazardous constituent loadings for this plant were excluded for purposes of calculating the overall flow-weighted average concentrations, but were included separately as part of total projected organics loadings for all POTWs in the United States. The difficulties in dealing with this POTW are indicative of the substantial, if not extreme,

TABLE 3-27. NATIONAL HAZARDOUS PRIORITY CONSTITUENT LOADINGS TO POTW INFLUENT

Inorganic Compounds	40 POTW Influent Frequency of Detection (%)	National Influent Loadings Based on 40 POTW Data (kg/yr)	National Influent Loadings Based on 39 POTW Data--POTW #28 Added separately (kg/yr)
Antimony	14	158,230	--
Arsenic	15	132,471	--
Cadmium	56	636,599	--
Chromium	95	5,151,668	--
Cyanide	100	15,120,147	--
Lead	62	4,386,278	--
Mercury	70	22,078	--
Nickel	79	3,013,726	--
Selenium	9	18,398	--
Silver	71	367,976	--
Total		28,717,499	
Organic Compounds			
Acenaphthylene	0	0	0
Acrolein	0	0	0
Acrylonitrile	0	0	0
Anthracene	18	29,430	29,430
Benzene	61	677,076	354,110
Bis(2-chloroethoxy)methane	0	0	0
Bis(2-chloroethyl)ether	0	0	0
Bis(2-ethyl hexyl)phthalate	92	1,847,241	1,712,750
Bromomethane	3	253,903	115,977
Butyl benzyl phthalate	57	596,121	345,298
Carbon tetrachloride	9	467,330	278,195
Chlorobenzene	13	139,830	136,304
p-chloro-m-cresol	3	7,359	11,007
Chloroethane	3	3,679	3,669
Chloroform	91	673,396	515,210
Chloromethane	11	831,626	316,698
2-Chloronaphthalene	1	3,679	132
Di-n-butyl phthalate	64	360,616	298,688
1,2-Dichlorobenzene	23	379,015	320,420
1,3-Dichlorobenzene	7	69,915	69,713
1,4-Dichlorobenzene	17	73,595	70,128
Dichlorodifluoromethane	2	412,133	412,133
1,1-Dichloroethane	31	33,117	33,237
1,2-Dichloroethane	15	17,320,646	7,699,450
1,1-Dichloroethylene	26	103,033	54,652
2,4-Dichlorophenol	7	7,359	7,338

TABLE 3-27. NATIONAL HAZARDOUS PRIORITY CONSTITUENT LOADINGS TO POTW INFLUENT (Continued)

Organic Compounds (Continued)	40 POTW Influent Frequency of Detection (%)	National Influent Loadings Based on 40 POTW Data (kg/yr)	National Influent Loadings Based on 39 POTW Data--POTW #28 Added separately (kg/yr)
1,2-Dichloropropane	7	772,750	50,455
Diethyl phthalate	53	125,111	121,628
2,4-Dimethylphenol	10	25,758	25,758
Dimethyl phthalate	11	33,117	33,171
Di-n-octyl phthalate	7	62,555	62,524
Ethylbenzene	80	1,162,805	963,386
Hexachlorobutadiene	0	0	0
Hexachloroethane	1	11,039	11,106
Methylene chloride	92	8,846,151	7,936,673
Naphthalene	49	298,060	294,574
Nitrobenzene	0	0	0
N-nitrosodimethylamine	0	0	0
PCB	1	11,039	11,007
Pentachlorophenol	29	250,224	249,997
Phenol	79	2,557,435	1,247,983
1,1,2,2-Tetachloroethane	7	44,157	44,161
Tetrachloroethylene	95	6,774,444	2,569,279
Toluene	96	10,391,651	3,232,279
Trans-1,2-dichloroethylene	62	165,569	155,297
Tribromomethane	2	3,679	3,768
1,2,4-Trichlorobenzene	10	316,459	330,220
1,1,1-Trichloroethane	85	12,356,645	2,503,328
1,1,2-Trichloroethane	7	55,196	48,246
Trichloroethylene	90	3,131,478	2,224,112
Trichlorofluoromethane	9	69,915	11,270
2,4,6-Trichlorophenol	5	3,679	7,338
Vinyl chloride	6	342,218	331,862
other organics (excl. pesticides)	--	147,190	111,218
Total		71,525,981	35,001,647

variation in loadings of organics, both priority and nonpriority, to individual POTWs throughout the Nation. Due to the highly site-specific nature of organics discharges to POTWs, the 40 POTW study cannot fully account for organics loadings to all POTWs.

As indicated in Table 3-27, a scale-up of 40 POTW data shows National POTW influent loading of approximately 29 million kilograms per year of hazardous metals and cyanide. The most frequently detected hazardous inorganic pollutants include cyanide (100 percent), chromium (95 percent), nickel (79 percent), silver (71 percent) and mercury (70 percent). Based on mass loadings to POTWs, the five largest loadings of hazardous inorganic pollutants are cyanide (15,120,147) kg/yr), chromium (5,151,668 kg/yr), lead (4,386,278 kg/yr), nickel (3,013,726 kg/yr), and cadmium (636,599 kg/yr).

A scale-up of 40 POTW sampling data, excluding the POTW receiving high volumes of organic waste, shows POTW influent loadings of approximately 35 million kilograms per year of organic priority hazardous constituents. The most frequently detected organics include toluene (96 percent), tetrachloroethylene (95 percent), methylene chloride (92 percent), bis(2-ethyl hexyl) phthalate (92 percent), chloroform (91 percent), trichloroethylene (90 percent), 1,1,1-trichloroethane (85 percent), ethyl benzene (80 percent), phenol (79 percent), and di-n-butyl phthalate (64 percent). Based on mass loadings, the 10 highest hazardous priority organics are methylene chloride (7,936,673 kg/yr), 1,2-dichloroethane (7,699,450 kg/yr), toluene (3,232,279 kg/yr), tetrachloroethylene (2,569,279 kg/yr), 1,1,1-trichloroethane (2,503,328 kg/yr), trichloroethylene (2,224,112 kg/yr), bis(2-ethyl hexyl) phthalate (1,712,750 kg/yr), phenol (1,247,983 kg/yr), ethyl benzene (963,386 kg/yr), and chloroform (515,210 kg/yr). Analysis of POTW influent data collected as part of the DSS study supports these results. Most of the organic compounds cited above, including phenol (389 detections), methylene chloride (241 detections), tetrachloroethylene (201 detections), toluene (192 detections), bis(2-ethyl hexyl) phthalate (167 detections), chloroform (166 detections), ethyl benzene (132 detections), 1,1,1-trichloroethane (118 detections) and trichloroethylene (108 detections), are among the compounds most frequently detected by more recent POTW sampling efforts. Both the 40 POTW and DSS sampling data show clearly the substantial loadings of common industrial solvents, particularly the chlorinated solvents and plasticizers.

3.5.2 Estimates of National POTW Loadings of Selected Nonpriority Organic Hazardous Constituents

Evaluation of 40 POTW, DSS, and Paragraph 4(c) plant influent data indicate the prevalence of commonly used solvents and plasticizers (e.g., tetrachloroethylene, methylene chloride, bis(2-ethyl hexyl) phthalate, etc.). These data suggest a possible correlation between production/use rates for specific compounds and their loadings to POTW influents. Regression analysis can be used to establish a statistical correlation between end use and influent loadings for hazardous organic priority constituents, and then to project loadings for selected nonpriority hazardous constituents.

In evaluating the correlation between use and discharge rates, two broad use types, "intermediate use" and "end use," were established. Intermediate use was defined to encompass use as a chemical intermediate in the organics industries, including the organic chemicals, dye manufacture, and pesticides industries. Together with discharges relating to actual production of a compound, this distinction delimits a set of several hundred possible industrial sources, including plants that produce the chemical, utilize the chemical as an intermediate in a production process, or generate the compound as a by-product. In many instances, a compound (e.g., vinyl chloride, acrolein, 1,2-dichloroethane, etc.) may be discharged in substantial quantities by a limited number of industrial sources. Based on this supposition, one would not expect to find any correlation between production or intermediate use and POTW influent loadings for compounds that are used predominantly as chemical intermediates.

By contrast, end use was defined to include a variety of uses by all other industries, such as electroplaters, equipment manufacturers, laundries, wood refinishers, pharmaceutical manufacturers, etc. This definition was intended to encompass more widespread use of a compound as a solvent, degreaser, dry cleaning agent, plasticizer, disinfectant, or similar use by a large number of industrial operations. In these instances, thousands or even tens of thousands of industrial sources can potentially discharge the compound to POTWs. Accordingly, one would expect a marked correlation between end use rates and loadings of these compounds to POTWs.

Due to the need to collect detailed production and use data for specific compounds, the analysis was limited to 40 organic hazardous constituents, including DSS Tier 1 organic constituents (i.e., F-code solvents) and selected DSS Tier 2 organic constituents frequently detected in POTW influents or believed to be widely used as industrial solvents. Data on production and use of these compounds were derived primarily from Stanford Research Institute's Chemical Economic Handbook (CEH) which, after review of numerous data sources, was determined to be the most comprehensive, up-to-date source of production/use information.(10) Because use data were not always sufficiently disaggregated by use type, project researchers utilized best professional judgment to apportion total use between intermediate and end use. Production/use data represent estimates for the year 1981, or, lacking these data, for the next closest year, corresponding to the sampling period (1979-1981) for the 40 POTW study. Accordingly, production/use values used for the analysis are not necessarily representative of current production/use values. Table 3-28 provides a summary of all production/use data utilized in the regression analysis.

POTW influent loadings for specific compounds are derived from 40 POTW plant sampling data. Regression analysis therefore focused exclusively on the selected organic priority constituents. Again, for the purpose of evaluating the correlation between influent loadings and end use, it was necessary to consider the possible effects of statistical outliers for organics discharges on National influent loadings. As a result, where organics data could reasonably be attributed to discharge from organics industries, the data were excluded for purposes of calculating flow-weighted hazardous constituent concentration averages used to project National loadings. This procedure resulted in the exclusion of organics data for one POTW (POTW #28) and a data point for 1,2-dichloroethane at another POTW (POTW #30). Constituent loadings used in the analysis are also summarized in Table 3-28.

TABLE 3-28. USE AND INFLUENT LOADINGS DATA FOR SELECTED HAZARDOUS ORGANIC CONSTITUENTS

Organic Constituent	Production Rate (kkg/yr)	Intermediate Use Rate (kkg/yr)	End Use Rate (kkg/yr)	Frequency of Detection 40 POTW (%)	National Influent Average Loading[1] (kkg/yr)
Toluene	4,652,550	4,163,400	597,150	96	3,232
1,1,1-Trichloroethane	279,450	119,250	274,950	85	2,503
Tetrachloroethylene	326,250	83,250	243,000	95	2,569
Xylene	3,012,750	3,021,300	233,100	--	--
Methyl ethyl ketone	210,600	0	199,350	--	--
Methylene chloride	266,400	42,750	192,600	92	7,937
Acetone	964,800	607,050	127,800	--	--
2-Ethyl hexyl phthalate	115,650	0	126,000	92	1,713
Phenols, phenolic resins	1,062,000	965,050	96,850	79	1,238
Dichlorodifluoromethane	225,000	0	90,000	2	412
Ethyl acetate	105,750	965,250	90,000	--	--
Trichloroethylene	99,000	15,750	85,500	90	2,224
Methanol	2,639,250	10,080	62,500	--	--
Butanol	355,950	2,639,250	54,600	--	--
Trichlorotrifluoroethane	59,090	246,150	54,545	--	--
Methyl isobutyl ketone	67,500	9,090	53,550	--	--
Ethyl benzene	2,995,200	6,750	41,400	80	963
Butyl benzyl phthalate	31,500	2,965,500	33,750	57	345
Cresol	61,650	0	33,300	--	--
Carbon tetrachloride	327,150	28,350	24,300	9	278
Isobutanol	56,700	259,200	15,750	--	--
Formaldehyde	953,100	51,750	14,850	--	--
Carbon disulfide	174,600	938,250	13,500	--	--
1,4-Dichlorobenzene	32,850	161,100	12,150	17	70
Chloromethane	211,363	9,900	9,000	11	316
Chlorobenzene	106,650	194,545	9,000	13	136
Benzene	3,496,500	103,050	9,000	61	354
Diethyl phthalate	7,650	0	9,000	53	122
Dibutyl phthalate	8,100	0	8,100	64	299
Chloroform	182,250	157,500	6,750	91	515
Trichlorofluoroethane	74,090	77,273	5,455	9	52
Ethyl ether	5,400	900	3,150	--	--
Analine	285,300	282,600	2,700	--	--
1,2-Dichlorobenzene	20,700	17,550	2,700	23	320
Nitrobenzene	405,900	404,100	2,250	--	0
Naphthalene	160,200	194,400	2,250	49	295
Dimethyl phthalate	2,250	0	2,250	11	33
1,2-Dichloroethane	5,670,900	5,670,900	900	--	--
Pyridine	6,750	6,300	315	--	--
Vinyl chloride	3,150,000	3,195,000	360	6	1
Dichloropropane	360	360	0	7	2

[1] Loadings are projected from 40 POTW flow-weighted pollutant concentrations, excluding organics data for POTW #28 and the 1,2-dichloroethane data point for POTW #30 (considered an outlier in the data set).

As anticipated, regression analysis demonstrated the absence of any statistical correlation between production or intermediate use and POTW influent loadings of the priority organics. This result was expected since the discharge of many organic compounds (e.g., vinyl chloride, 1,2-dichloroethane) probably was associated with a limited number of possible industrial sources whose significance was likely to be either overrepresented or underrepresented by a limited POTW sample size (i.e., in this instance, 40 POTWs).

The regression analysis did demonstrate a marked correlation between end use of specific compounds and their discharge to POTWs. Figure 3-5 provides a scatter plot that illustrates this correlation between end use and POTW influent loadings. A linear regression procedure established the following relationship between end use and POTW influent loadings:

$$Y = 458 + .007\ X \qquad (R^2 = .28)$$

where, Y = POTW influent loadings (kkg/yr)
X = End use (kkg/yr)

This equation has a correlation coefficient of 0.53, while the end use coefficient has a t value of 3.07, indicating statistical significance at a 95 percent confidence level. This relationship indicates that approximately 0.7 of 1 percent of the quantity of a compound that finds end use ultimately will be discharged to a POTW. Even with the inclusion of organics data for POTW #28 and POTW #30, there is still a significant correlation between end use rates and influent loadings, although projected loadings rates are markedly higher (i.e., 1.9 percent of all end use). Due to data constraints, the analysis did not consider other factors, such as treatment, incorporation into final products, and volatility in collection systems, which also may be statistically significant in predicting POTW influent loadings of these compounds.

Based on the above analysis, Table 3-29 projects National POTW influent loadings, attributable solely to end use, for selected nonpriority hazardous constituents. These loadings do not account for loadings stemming from

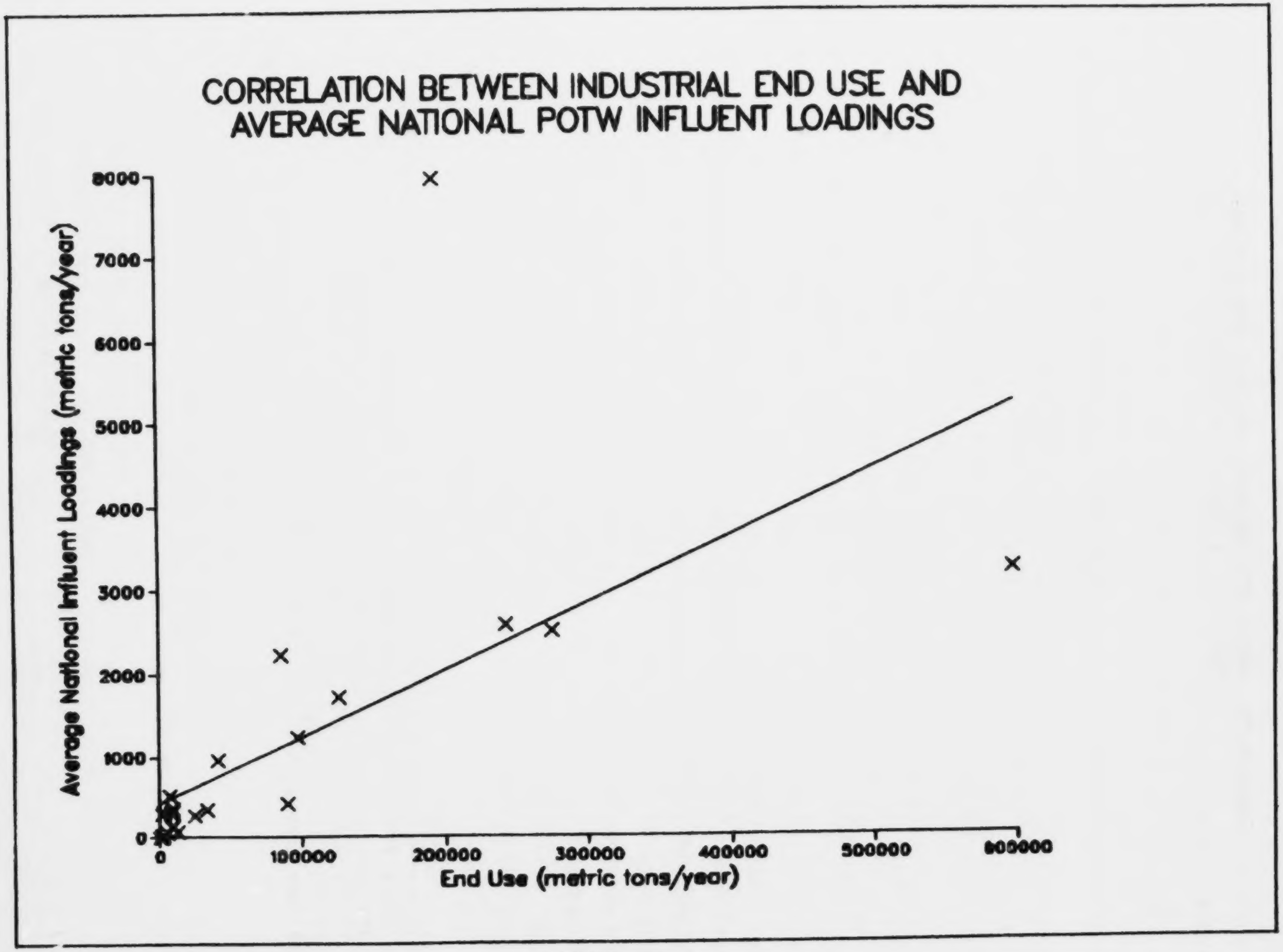
CORRELATION BETWEEN INDUSTRIAL END USE AND AVERAGE NATIONAL POTW INFLUENT LOADINGS
Average National Influent Loadings (metric tons/year)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
100000
200000
300000
400000
500000
600000
End Use (metric tons/year)

FIGURE 3-5

TABLE 3-29. PROJECTED INFLUENT LOADINGS FOR SELECTED NONPRIORITY ORGANIC HAZARDOUS CONSTITUENTS

Hazardous Constituent	End Use (kkg/yr)	Projected Influent Loadings[1] (kkg/yr)
Xylenes	233,100	1,678
Methyl ethyl ketone	199,350	1,435
Acetone	127,800	920
Ethyl acetate	90,000	648
Methanol	65,250	470
Butanol	54,000	389
Trichlorotrifluoroethane	54,000	389
Methyl isobutyl ketone	53,550	386
Cresol	33,300	240
Isobutanol	15,750	113
Formaldehyde	14,850	107
Carbon disulfide	13,500	97
Ethyl ether	3,150	23
Aniline	2,700	19
Pyridine	315	2

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[1] This table estimates POTW influent loadings attributable solely to end use by nonorganics industries. As indicated in Section 3.2 and in the discussion of the 40 POTW study results, organics industries may discharge substantial additional quantities of these same compounds (e.g., xylene, acetone, formaldehyde, etc.).

production or intermediate use by the organics industries. These projections indicate that nonpriority hazardous constituents, such as xylene, methyl ethyl ketone, acetone, ethyl acetate, and methanol, may be present in significant quantities in POTW influent wastewaters. These conclusions are supported by limited POTW sampling data collected for both the Paragraph 4(c) program and for this study. Table 3-30 provides a summary of the organic hazardous constituents, both priority and nonpriority, most frequently detected in the Paragraph 4(c) sampling program. Many of the compounds appearing on this list are the same compounds that are projected to occur in significant quantities in POTW influents Nationally. Moreover, DSS POTW sampling data demonstrate the presence, in significant concentrations, of these compounds in POTW influents, including xylene, cresol, methyl ethyl ketone, methyl isobutyl ketone, acetone, acetophenone, and aniline.

3.5.3 Production/Use Profiles for Selected Hazardous Organic Constituents

This portion of Section 3.5 provides production/use profiles for selected hazardous organic constituents known or believed to be common in POTW influent wastewaters. Each profile contains a summary of pertinent numerical data for the compound, a narrative description of significant intermediate and end use of the compound, and a listing of the industrial categories (nonorganic industries only) that have been identified as major end users of the chemical. End use data were derived from the SRI Chemical Economic Handbook.(10) The listing of industrial categories does not consider intermediate use by the organics industries (i.e., organic chemicals, dye manufacture, and pesticides); most of the compounds discussed below find substantial use in these industries.

Acetone

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 920 kkg/yr
Production Rate: 964,800 kkg/yr
Intermediate Use Rate: 607,050 kkg/yr
End Use Rate: 127,800 kkg/yr

TABLE 3-30. OCCURRENCE OF HAZARDOUS ORGANIC CONSTITUENTS AT POTWS BASED ON PARAGRAPH 4(c) SAMPLING DATA

Hazardous Organic Constituent	Number of Detections
Tetrachloroethylene*	226
Cresol	169
Methylene Chloride*	157
Trichloroethylene*	123
Benzene*	114
Xylene	112
Toluene*	111
Chloroform*	107
Ethyl Benzene*	93
1,1,1-Trichloroethane*	90
Phenol*	80
Bis(2-Ethyl Hexyl)Phthalate*	46
Napthalene*	41
1,1-Dichloroethylene*	39
Diethyl Phthalate*	35
Acetone	33
Methyl Isobutyl Ketone	30
Di-N-Butyl Phthalate*	28
Di-N-Octyl Phthalate*	26
2,4-Dimethyl Phenol*	24
1,2-Dichlorobenzene*	17
Trans-1,2-Dichloroethylene*	16
1,3-Dichlorobenzene*	14
1,4-Dichlorobenzene*	13
Aniline	12
PCB*	11
Methyl Ethyl Ketone	10
Butyl Benzyl Phthalate*	10
Acetophenone	7
Cyclohexane	7
Carbon Disulfide	6
2-Picoline	6
1,1-Dichloroethane*	4
Pentachlorophenol*	4
2,4,6-Trichlorophenol*	4
1,2,4-Trichlorobenzene*	4
Chlorobenzene*	3
Pyridine	3
Ethyl Ether	2
1,2-Dichloropropane*	2
Ethyl Acetate	2
Trichlorofluoromethane*	1
1,1,2-Trichloroethane*	1
Cyclohexanone	1
1,4-Dioxane	1

*Denotes CWA priority pollutant.

Source: Reference (6)

Acetone is an intermediate in the production of methyacrylic acids and esters, methyl isobutyl ketone, bisphenol A, methyl isobutyl carbinol, aldol chemicals, and certain drugs and pharmaceuticals. It also is used as a solvent for surface coatings, adhesives, printing inks, and paper coatings. The synthetic fibers industry uses acetone as a spinning solvent in the manufacture of cellulose acetate fiber. Other uses for acetone include using the chemical as a solvent for acetylene, cellulose acetate sheeting, smokeless powder, cements, and artificial leather, and as an extraction solvent in the dewaxing of lubricating oils. The electronics industry uses acetone to clean and dry printed circuits. Key industrial categories for end use include:

- Pharmaceuticals
- Paint
- Electronics
- Plastics forming
- Printing/publishing
- Ink
- Equipment manufacturing
- Wood refinishing
- Electroplating.

Aniline

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 19 kkg/yr
Production Rate: 285,300 kkg/yr
Intermediate Use Rate: 282,600 kkg/yr
End Use Rate: 2,700 kkg/yr

Aniline is used primarily as a chemical intermediate. The chemicals that are produced from this compound include MDI, various rubber-processing chemicals, agricultural chemicals, hydroquinone, dyes, and pharmaceuticals. Other miscellaneous uses are as raw material for sodium and calcium N-cyclohexanesulfomates, as an analytical reagent and corrosion inhibitor, and in photographic chemicals and specialty resins and fibers. Key industrial categories for end use include:

- Pharmaceuticals
- Photographic chemicals.

Benzene

40 POTW Influent Frequency of Detection: 61 percent
Projected National Loadings to POTW Influent: 354 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 3,496,500 kkg/yr
Intermediate Use Rate: 5,008,500 kkg/yr
End Use Rate: 9,000 kkg/yr

Almost all of the domestic consumption of benzene can be accounted for by the production of ethyl benzene, cumene, cyclohexane, nitrobenzene, detergent alkylate, chlorobenzenes, and maleic anhydride. Other smaller intermediate uses include the production of benzene hexachloride, benzene sulfonic acid, biphenyl, hydroquinone, and resorcinol. Benzene has many small-volume markets as a solvent, but has no major solvent application. As an aromatic, benzene is a significant constituent of petroleum products such as stoddard solvent, kerosene, naphtha, etc. Key industrial categories for end use include:

- Laundries
- Paint
- Equipment manufacturing
- Motor vehicle services
- Pharmaceuticals
- Transportation.

Bis(2-ethylhexyl) Phthalate

40 POTW Influent Frequency of Detection: 92 percent
Projected National Loadings to POTW Influent: 1,713 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 115,650 kkg/yr
Intermediate Use Rate: 0 kkg/yr
End Use Rate: 126,000 kkg/yr

Bis(2-ethylhexyl) phthalate is used most widely as a PVC plasticizer, primarily in the production of calandered film, sheeting, and coated fabrics. It also has applications with polyvinylidene chloride synthetic elastomers, and is used as a carrier and dispersing medium for other substances, such as catalysts and intiators, pesticides, cosmetics, and colorants. High-purity di(2-ethylhexyl)phthalate also is being used to replace PCBs as capacitor fluid. Key industrial categories for end use include:

- Plastics forming
- Paint
- Equipment manufacturing
- Electronics.

Butanol

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 389 kkg/yr
Production Rate: 355,950 kkg/yr
Intermediate Use Rate: 246,150 kkg/yr
End Use Rate: 54,000 kkg/yr

Butanol is a solvent in paints and other surface coatings, and a processing and formulating solvent for pharmaceuticals, waxes, and other resins. As an intermediate, it is used to manufacture butyl acrylate/methacrylate, glycol ethers, butyl acetate, plasticizers, amino resins, and butylamine. It also is used as a cosolvent in tertiary oil recovery. Key industrial categories for end use include:

- Paint
- Pharmaceuticals.

Butyl Benzyl Phthalate

40 POTW Influent Frequency of Detection: 57 percent
Projected National Loadings to POTW Influent: 345 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A

Production Rate: 31,500 kkg/yr
Intermediate Use Rate: 0 kkg/yr
End Use Rate: 33,750 kkg/yr

Butyl benzyl phthalate is a plasticizer used primarily for PVC flooring, often with bis(2-ethyl hexyl) phthalate. It also is used in polyvinyl acetate emulsions. Key industrial categories for end use include:

- Plastics forming
- Paint
- Equipment manufacturing.

Carbon Disulfide

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 97 kkg/yr
Production Rate: 174,600 kkg/yr
Intermediate Use Rate: 161,100 kkg/yr
End Use Rate: 13,500 kkg/yr

The primary use of carbon disulfide is to manufacture rayon and celloplane from regenerated cellulose and to synthesize carbon tetrachloride. Carbon disulfide also functions as a rubber accelerator and a flotation agent, and is used in the manufacture of pesticides and thiocyanates. There are no key industrial categories for end use.

Carbon Tetrachloride

40 POTW Influent Frequency of Detection: 9 percent
Projected National Loadings to POTW Influent: 278 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 327,150 kkg/yr
Intermediate Use Rate: 259,200 kkg/yr
End Use Rate: 24,300 kkg/yr

Carbon tetrachloride serves as an intermediate in the production of fluorocarbons and various other organic compounds. It is used as a solvent for metal degreasing, and for oils, fats, lacquers, varnishes, rubber compounds, waxes, and resins. It has several uses in veterinary medicine and as a pesticide. Other uses are as an extractant and as a drying agent for spark plugs. Key industrial categories for end use include:

- Laundries
- Food processing
- Equipment manufacturing
- Pharmaceuticals
- Paint.

Chlorobenzene

40 POTW Influent Frequency of Detection: 13 percent
Projected National Loadings to POTW Influent: 136 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 106,650 kkg/yr
Intermediate Use Rate: 103,050 kkg/yr
End Use Rate: 9,000 kkg/yr

Chlorobenzene (monochlorobenzene) is used most widely as a solvent in the formulation of various insecticides and herbicides as well as MDI and TDI (Toluene diisocyanate). It also is widely used as a degreaser for automobile parts. Intermediate uses include the manufacture of nitrochlorobenzene, diphenyl oxide, phenol, o- and p-phenylphenol, aniline, and silicon resin producers. Key industrial categories for end use include:

- Motor vehicle services
- Transportation
- Pharmaceuticals.

Chloroform

40 POTW Influent Frequency of Detection: 91 percent
Projected National Loadings to POTW Influent: 515 kkg/yr

Projected POTW Influent Loadings due to End Use: N/A

Production Rate: 182,250 kkg/yr

Intermediate Use Rate: 157,500 kkg/yr

End Use Rate: 6,750 kkg/yr

Ninety percent of the chloroform consumption is used to manufacture chlorodifluoromethane. Other applications include use as a solvent for pharmaceuticals, as a soil fumigant, as an extraction solvent for essential oils, and use by the tobacco industry to prevent the mildewing of seedings. Key industrial categories for end use include:

- Pharmaceuticals
- Hospitals.

Chloromethane

40 POTW Influent Frequency of Detection: 11 percent

Projected National Loadings to POTW Influent: 316

Projected POTW Influent Loadings due to End Use: N/A

Production Rate: 211,363 kkg/yr

Intermediate Use Rate: 194,545 kkg/yr

End Use Rate: 9,000 kkg/yr

Chloromethane is used to manufacture methyl cellulose, quaternary ammonium compounds, triptane, 2,2,3-trimethyl butane, methyl mercaptan, and various pesticides. Its primary use, however, is as an intermediate for methylene chloride, chloroform, methylchlorosilanes, and trimethyl lead. It is also a solvent for polymeration catalysts used to make butyl rubbers. There are no key industrial categories for end use.

Cresols

40 POTW Influent Frequency of Detection: N/A

Projected National Loadings to POTW Influent: N/A

Projected POTW Influent Loadings due to End Use: 240 kkg/yr

Production Rate: 61,650 kkg/yr

Intermediate Use Rate: 28,350 kkg/yr

End Use Rate: 33,300 kkg/yr

Cresols include both mixed cresols and p-, o-, and m-cresol isomers. These compounds are used primarily as intermediates in the production of antioxidants such as 2,6-di-tert-butyl-p-cresol (BHT), salicylaldehyde, specialty resins, herbicides, insecticides, pharmaceuticals, and phosphate esters. They also function as wire enamel solvents, ore flotation frothers, disinfectants, fiber treatments, tanning agents, and metal degreasings agents. Key industrial categories for end use include:

- Electroplating
- Equipment manufacturing
- Textiles
- Leather tanning
- Wood refinishing
- Hospitals
- Pharmaceuticals
- Transportation.

Di-N-Butyl Phthalate

40 POTW Influent Frequency of Detection: 64 percent
Projected National Loadings to POTW Influent: 299 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 8,100 kkg/yr
Intermediate Use Rate: 0 kkg/yr
End Use Rate: 8,100 kkg/yr

Dibutyl phthalate, also a plasticizer, is used primarily with adhesive emulsions and, to some extent, plastisols for carpet backcoating. Key industrial categories for end use include:

- Plastics forming
- Adhesives
- Paint
- Equipment manufacturing.

1,2-Dichlorobenzene

40 POTW Influent Frequency of Detection: 23 percent
Projected National Loadings to POTW Influent: 320 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 20,700 kkg/yr
Intermediate Use Rate: 17,550 kkg/yr
End Use Rate: 2,700 kkg/yr

1,2-dichlorobenzene has its largest use in the production of various organic chemicals, primarily 3,4-dichloroaniline. It also is used as a process solvent in toluene diisocyanate production and as a solvent for paint removers, engine cleaners, and deinking processes. 1,2-dichlorobenzene has some use in dye manufacturing. Key industrial categories for end use include:

- Wood finishing
- Equipment manufacturing
- Printing/publishing
- Motor vehicle services.

Dichlorodifluoromethane

40 POTW Influent Frequency of Detection: 2 percent
Projected National Loadings to POTW Influent: 412 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 225,000 kkg/yr
Intermediate Use Rate: 22,500 kkg/yr
End Use Rate: 90,000 kkg/yr

Dichlorodifluoromethane is a fluorocarbon that is used most often as a coolant in refrigeration units and as a blowing agent in manufacturing flexible and rigid polyurethane foams. Smaller amounts function as chemical intermediates and are used to sterilize surgical and pharmaceutical equipment. It also may be used for food freezing and as a component of fire extinguishers. Key industrial categories for end use include:

- Service-related industries
- Plastics forming
- Hospitals.

1,2-Dichloroethane

40 POTW Influent Frequency of Detection: 15 percent
Projected National Loadings to POTW Influent: 7,699 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 5,670,900 kkg/yr
Intermediate Use Rate: 5,670,900 kkg/yr
End Use Rate: 900 kkg/yr

1,2-dichloroethane is a major intermediate in the production of vinyl chloride. An extremely small amount is used as a solvent for vinyl chloride, in surface coatings, as a degreasing solvent, as a wetting and penetrating agent, and as a lead scavenger in gasoline. Key industrial categories for end use include:

- Paint
- Equipment manufacturing
- Motor vehicle services
- Textiles.

1,4-Dichlorobenzene

40 POTW Influent Frequency of Detection: 17 percent
Projected National Loadings to POTW Influent: 70 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 32,850 kkg/yr
Intermediate Use Rate: 9,900 kkg/yr
End Use Rate: 12,150 kkg/yr

1,4-dichlorobenzene is used primarily in room deodorant blocks. It also is used in moth control chemicals and to manufacture polyphenylene sulfide resins. There are no key industrial categories for end use.

Diethyl Phthalate

40 POTW Influent Frequency of Detection: 53 percent
Projected National Loadings to POTW Influent: 122 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 7,650 kkg/yr
Intermediate Use Rate: 0 kkg/yr
End Use Rate: 9,000 kkg/yr

Diethyl phthalate is a plasticizer that is used almost entirely with cellulose ester plastics. Only a small amount is used with polyurethane casting compounds. Key industrial categories for end use include:

- Plastics forming
- Paint
- Equipment manufacturing.

Dimethyl Phthalate

40 POTW Influent Frequency of Detection: 11 percent
Projected National Loadings to POTW Influent: 33 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 2,250 kkg/yr
Intermediate Use Rate: 0 kkg/yr
End Use Rate: 2,250 kkg/yr

Dimethyl phthalate, like diethyl phthalate, is a plasticizer used almost exclusively for cellulose ester plastics. It has few other uses. Key industrial categories for end use include:

- Plastics forming
- Paint
- Equipment manufacturing.

Ethyl Acetate

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 648 kkg/yr
Production Rate: 105,750 kkg/yr
Intermediate Use Rate: 15,750 kkg/yr
End Use Rate: 90,000 kkg/yr

Most of ethyl acetate's use occurs in the surface coatings, plastics, and printing industries where it is used as a solvent for cellosics and shellacs, synthetic rubber and vinyl resins, and printing inks. Only a small portion of the total ethyl acetate production is used for chemical synthesis. Key industrial categories for end use include:

- Paint
- Ink
- Printing/publishing
- Plastics forming.

Ethyl Benzene

40 POTW Influent Frequency of Detection: 80 percent
Projected National Loadings to POTW Influent: 963 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 2,995,200 kkg/yr
Intermediate Use Rate: 2,965,500 kkg/yr
End Use Rate: 41,400 kkg/yr

Ninety-nine percent of all ethyl benzene is used to make styrene. Most of the remaining 1 percent is used as a solvent, although some may be used to produce diethyl benzene, acetophenone, and ethyl anthroquinone. Ethyl benzene is a significant (i.e., 3-5 percent) constituent of mixed xylene solvents. Key industrial categories for end use include:

- Laundries
- Paint

- Equipment manufacturing
- Motor vehicle services
- Pharmaceuticals
- Transportation.

Ethyl Ether

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 23 kkg/yr
Production Rate: 5,400 kkg/yr
Intermediate Use Rate: 900 kkg/yr
End Use Rate: 3,150 kkg/yr

The largest use of ethyl ether is as a solvent in the production of smokeless powder. Smaller amounts are used as chemical intermediates, as a general anesthetic, and other medicinal uses. Miscellaneous uses include its use as a denaturant for ethyl alcohol. Key industrial categories for end use include:

- Pharmaceuticals
- Hospitals.

Formaldehyde

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 107 kkg/yr
Production Rate: 953,100 kkg/yr
Intermediate Use Rate: 938,250 kkg/yr
End Use Rate: 14,850 kkg/yr

Formaldehyde is an intermediate in manufacturing urea-formaldehyde resins, phenolic resins, acetylenic chemicals, polyacetyl resins, pentaenrythritol, hexamethylene tetramine, melamine resins, trimethylolethane, nitroparaffin, pyridine chemicals, trimethylolpropane, chelating agents, 4,4-methylene bis(phenyl isocyanate) (MDI), dyes, drilling mud additives, and rubber processing chemicals. The textile industry uses formaldehyde in various textile-treating applications. It also is used in small amounts as a preservative. Key industrial categories for end use include:

- Textiles
- Service-related industries
- Pharmaceuticals
- Pulp/paper
- Photographic chemicals
- Wood refinishing.

Isobutanol

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 113 kkg/yr
Production Rate: 56,700 kkg/yr
Intermediate Use Rate: 51,750 kkg/yr
End Use Rate: 15,750 kkg/yr

Isobutanol often replaces butanol in surface coatings. The pharmaceutical and pesticide industries also use it as a processing solvent. As an intermediate, it is used in manufacturing isobutyl amine, lube oil additives, isobutyl acetate, gasoline octane improvers, isobutyl acrylate and methacrylate, and amino resins. Key industrial categories for end use include:

- Paint
- Pharmaceuticals
- Photographic chemicals.

Methanol

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 470 kkg/yr
Production Rate: 3,212,550 kkg/yr

Intermediate Use Rate: 2,639,250 kkg/yr
End Use Rate: 65,250 kkg/yr

The primary end uses of methanol are as a fuel, as a solvent in automatic chemicals such as windshield washer solvent and surface coatings, and as an antifreeze. It is used as an intermediate in the production of formaldehyde, acetic acid, chloromethanes, methyl tertiary butyl ether, dimethyl terephthalate, methylmethacrylate, methylamines, glycolmethyl ethers, and as a inhibitor of formaldehyde. Key industrial categories for end use include:

- Motor vehicle services
- Wood refinishing
- Paint
- Pharmaceuticals
- Equipment manufacturing
- Transportation.

Methylene Chloride

40 POTW Influent Frequency of Detection: 92 percent
Projected National Loadings to POTW Influent: 7,937 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 266,400 kkg/yr
Intermediate Use Rate: 42,750 kkg/yr
End Use Rate: 192,600 kkg/yr

Methylene chloride has no major chemical market as an intermediate, and is used primarily as a solvent for paint removers, in vapor degreasing operations, as an aerosol propellants, and as a blowing agent for urethane foams. Other uses are in the processing of plastics and film; as a solvent in numerous pharmaceutical applications; in the extraction of naturally occurring heat-sensitive substances, caffeine from coffee, and beer flavoring from hops; in the manufacture of photographic fiber and synthetic fiber; and as a component of fire-extinguishing compounds. Key industrial categories for end use include:

- Wood refinishing
- Equipment manufacturing
- Electroplating
- Motor vehicle services
- Transportation
- Photographic chemicals
- Pharmaceuticals
- Food processing.

Methyl Ethyl Ketone

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 1,435 kkg/yr
Production Rate: 210,600 kkg/yr
Intermediate Use Rate: 0
End Use Rate: 199,350 kkg/yr

Methyl ethyl ketone is used as a solvent, primarily for surface coatings, but also for printing inks and magnetic tapes and as an extraction solvent for lube oil dewaxing and hardwood pulping. Key industrial categories for end use include:

- Paint
- Ink
- Electronics
- Printing/publishing
- Pulp/paper
- Adhesives
- Pharmaceuticals
- Equipment manufacturing.

Methyl Isobutyl Ketone (MIbK)

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 386 kkg/yr

Production Rate: 67,500 kkg/yr
Intermediate Use Rate: 6,750 kkg/yr
End Use Rate: 53,550 kkg/yr

Methyl isobutyl ketone is used as a solvent for nitrocellulose lacquers and coating resins, such as vinyl polymer and copolymer and acrylic resins. Other solvent uses are in the extraction of rare metals, agricultural insecticides, adhesives, and dewaxing mineral and tall oil. MIbK also is used as a raw material for antioxidants such as N-(1,3,-dimethyl butyl)-N-phenyl paraphenylene diamine, and is used extensively in the pharmaceutical industry as a solvent. Key industrial categories for end use include:

- Paint
- Adhesives
- Pharmaceuticals
- Equipment manufacturing.

Naphthalene

40 POTW Influent Frequency of Detection: 49 percent
Projected National Loadings to POTW Influent: 295 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 160,200 kkg/yr
Intermediate Use Rate: 194,400 kkg/yr
End Use Rate: 2,250 kkg/yr

Naphthalene is used primarily as a chemical intermediate. Phthalic anhydride production uses the largest amount of naphthalene, followed by the production of carbaryl, betanapthol, surface-active agents, tanning agents (syntans), and moth repellant. Miscellaneous uses include its use as an intermediate for dyes, a stabilizer for rubber chemicals, and as a solvent for various oils, resins, and waxes. It also may be used as an intermediate for asphalt components and stabilizers. Key industrial categories for end use include:

- Motor vehicle services
- Laundries
- Equipment manufacturing
- Transportation.

Nitrobenzene

40 POTW Influent Frequency of Detection: 0 percent
Projected National Loadings to POTW Influent: 0 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 405,900 kkg/yr
Intermediate Use Rate: 404,100 kkg/yr
End Use Rate: 2,250 kkg/yr

Ninety-eight percent of all nitrobenzene is used to produce aniline. The remainder is used to produce N-acetyl-para-amino-phenol (APAP), as a dye intermediate, as a solvent for cellulose ether, and as a selective solvent in the petroleum industry. There are no key industrial categories for end use.

Phenol

40 POTW Influent Frequency of Detection: 79 percent
Projected National Loadings to POTW Influent: 1,238 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 1,062,000 kkg/yr
Intermediate Use Rate: 965,250 kkg/yr
End Use Rate: 96,850 kkg/yr

Phenol is an intermediate for phenolic resins, epoxy resins, bisphenol A, caprolactem, xylenols, adipic acid, salicylic acid, monylphenol, and dodecylphenol. It is used as a solvent in petroleum refining, has intermediate uses in the production of aniline, phosphate esters, and herbicide production, and has miscellaneous uses in dyes and pharmaceuticals. It also is used to make pentachlorophenol (PCP). Key industrial categories for end use include:

- Pharmaceuticals
- Transportation

- Wood refinishing
- Equipment manufacturing
- Hospitals.

Pyridine

40 POTW Influent Frequency of Detection: N/A

Projected National Loadings to POTW Influent: N/A

Projected POTW Influent Loadings due to End Use: 2 kkg/yr

Production Rate: 6,750 kkg/yr

Intermediate Use Rate: 6,300 kkg/yr

End Use Rate: 315 kkg/yr

Pyridine functions as a major intermediate in the production of such agricultural chemials as paraquat and diquat. Other intermediate uses are in the pharmaceuticals and cosmetics industries. It also has small solvent uses in the pharmaceutical and textile industries. Key industrial categories for end use include:

- Pharmaceuticals
- Textiles.

Tetrachloroethylene

40 POTW Influent Frequency of Detection: 95 percent

Projected National Loadings to POTW Influent: 2,569 kkg/yr

Projected POTW Influent Loadings due to End Use: N/A

Production Rate: 326,250 kkg/yr

Intermediate Use Rate: 83,250 kkg/yr

End Use Rate: 243,000 kkg/yr

Tetrachloroethylene, or perchloroethylene, is used primarily as a metal cleaner and degreaser and as a solvent in dry cleaning and textile processing. Smaller amounts are used as intermediates in the production of such fluorocarbons as trichlorotrifluoroethane, dichlorotetrafluoroethane, chloropentafluoroethane, and hexafluoroethane. Key industrial categories for end use include:

- Laundries
- Wood refinishing
- Textiles
- Electroplating
- Equipment manufacturing
- Motor vehicle services
- Electronics
- Transportation
- Pharmaceuticals.

Toluene

40 POTW Influent Frequency of Detection: 96 percent

Projected National Loadings to POTW Influent: 3,232 kkg/yr

Projected POTW Influent Loadings due to End Use: N/A

Production Rate: 4,652,550 kkg/yr

Intermediate Use Rate: 4,163,400 kkg/yr

End Use Rate: 597,150 kkg/yr

Toluene blended back into gasoline is the largest single use for the chemical. Sixty-five percent of the remaining toluene is used to produce benzene through hydrodealkylation and 26 percent is used for solvents in surface coatings, adhesives, inks, and pharmaceuticals. The remainder is used to produce toluene diisocyanate, vinyl toluene, cresols, benzaldehyde, toluene sulfonic acids, toluene sulfonates, benzotrichloride, toluene diamine, chlorotoluenes, toluene sulfonyl chloride, nitrotoluene, para-tert-butyl benzoic acid, and is used for disproportionation to benzene and xylenes and as a denaturant. Trinitrotoluene (TNT) was manufactured from toluene until the late 1970s, at which time domestic production of TNT ceased. As an aromatic, toluene is a significant constituent of petroleum products, such as stoddard solvent, kerosene, naphtha, etc. Key industrial categories for end use include:

- Paint
- Adhesives
- Ink

- Pharmaceuticals
- Laundries
- Wood refinishing
- Equipment manufacturing
- Electroplating
- Motor vehicle services
- Transportation.

1,1,1-Trichloroethane

40 POTW Influent Frequency of Detection: 85 percent
Projected National Loadings to POTW Influent: 2,503 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 279,450 kkg/yr
Intermediate Use Rate: 119,250 kkg/yr
End Use Rate: 274,950 kkg/yr

1,1,1-Trichloroethane is used primarily as a metal cleaning solvent, particularly on electric machinery, plastics, and other items that might be adversely affected by another solvent. It is also a component of aerosol formulations, and is used as a chemical intermediate, a solvent in adhesives and coatings formulations, a coolant and lubricant in cutting oils, an extraction solvent, a drain cleaner, and a solvent in inks and fabric spotting fluid. Key industrial categories for end use include:

- Electronics
- Plastics forming
- Paint
- Adhesives
- Motor vehicle services
- Ink
- Pharmaceuticals
- Electroplating
- Equipment manufacturing
- Transportation.

Trichloroethylene

40 POTW Influent Frequency of Detection: 90 percent
Projected National Loadings to POTW Influent: 2,224 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 99,000 kkg/yr
Intermediate Use Rate: 10,800 kkg/yr
End Use Rate: 85,500 kkg/yr

Trichloroethylene, like the other chlorinated solvents 1,1,1-Trichloroethane and tetrachloroethylene, is used primarily as a solvent for metal cleaning and degreasing. It also is used as a chain terminator in the production of PVC and to produce chloroacetic acid. Key industrial categories for end use include:

- Equipment manufacturing
- Electroplating
- Motor vehicle services
- Laundries
- Transportation.

Trichlorotrifluoroethane

40 POTW Influent Frequency of Detection: 9 percent
Projected National Loadings to POTW Influent: NA
Projected POTW Influent Loadings due to End Use: 389 kkg/yr
Production Rate: 59,090 kkg/yr
Intermediate Use Rate: 9,090 kkg/yr
End Use Rate: 54,545 kkg/yr

Trichlorotrifluoroethane is a fluorocarbon that is used as a refrigerant and a blowing agent in the polyurethane, polystyrene, and polyethylene foams. It also is used heavily as a solvent in the electronics and aerospace industries for metal degreasing, cleaning semiconductor wafers, printed circuit boards, and glass, and for plasma etching of printed circuit boards. In textile processing, it is used for scouring finishing oils, drying yarn and fabric, drycleaning, and as a chemical reaction medium. As a chemical intermediate, it is a precursor to chlorotrifluoroethylene, among others. Key industrial categories for end use include:

- Service-related industries
- Electronics
- Textiles.

Trichlorofluoromethane

40 POTW Influent Frequency of Detection: 9 percent
Projected National Loadings to POTW Influent: 52 kkg/yr
Projected POTW Influent Loadings due to End Use: NA
Production Rate: 74,090 kkg/yr
Intermediate Use Rate: 77,230 kkg/yr
End Use Rate: 5,455 kkg/yr

Trichlorofluoromethane has its largest use as a blowing agent for polyurethane, polystyrene, and polyethylene foams. Other uses are as a refrigerant and a solvent in the electronics and textile industries. It has minor uses as a chemical intermediate and sterilization medium. Key industrial categories for end use include:

- Equipment manufacturing
- Electronics
- Electroplating
- Textiles
- Service-related industries.

Vinyl Chloride and 1,2-Dichloropropane

40 POTW Influent Frequency of Detection: 6/7 percent
Projected National Loadings to POTW Influent: 332/50 kkg/yr
Projected POTW Influent Loadings due to End Use: N/A
Production Rate: 3,150,00/360 kkg/yr
Intermediate Use Rate: 3,195,000/360 kkg/yr
End Use Rate: 0/0 kkg/yr

Vinyl chloride and 1,2-dichloropropane function wholly as chemical intermediates. Most vinyl chloride is used to make polyvinyl chloride, but some also is used to make vinylidene chloride copolymer, and is used as a comonomer and an intermediate in the production of certain solvents. Dichloropropane is an intermediate in the production of certain pesticides. There are no key industrial categories for end use.

Xylenes

40 POTW Influent Frequency of Detection: N/A
Projected National Loadings to POTW Influent: N/A
Projected POTW Influent Loadings due to End Use: 1,678 kkg/yr
Production Rate: 3,012,750 kkg/yr
Intermediate Use Rate: 3,021,300 kkg/yr
End Use Rate: 233,100 kkg/yr

Xylenes include ortho-xylene, meta-xylene, para-xylene, and mixtures of the three. Mixed xylenes are a source for individual isomer isolation, but also are used as solvents and a high-octane component of gasoline. In smaller amounts they are used as chlorinated plasticizers and as an intermediate in paints and coatings, adhesives, rubber products, chemical manufacturing, and agricultural products. The individual xylene isomers are used as chemical intermediates. As an aromatic, xylenes may be significant constituents of petroleum products, such as stoddard solvent, naphtha, kerosene, etc. Key industrial categories for end use include:

- Paint
- Adhesives
- Laundries
- Pharmaceuticals
- Motor vehicle services
- Electroplating
- Equipment
- Equipment manufacturing
- Wood refinishing.

3.6 RESIDENTIAL CONTRIBUTION TO POTW INFLUENT LOADINGS

Previous sections of Chapter 3 have provided estimates of hazardous waste and constituent loadings to POTWs from nondomestic sources. This section estimates priority hazardous constituent discharges to POTWs by residential sources. The analysis demonstrates that residential sources are a small but significant source of hazardous constituent loadings to POTWs.

The analysis of residential loadings utilizes POTW sampling data from two EPA/OW studies. As part of the Four City Study, EPA conducted sampling at a variety of sites, including residential sites, commercial sites, industrial sites, POTW influent, and tap water.(31) Sampling data from both residential (47 samples) and commercial sites (42 samples) were evaluated in determining representative constituent concentrations for domestic sources. As part of the 40 POTW Study,(29) EPA conducted sampling at two POTWs (#2 and #9) that were known to receive minimal wastewater contributions from industrial sources. To supplement data provided by the Four City Study, influent sampling data for these two plants also were incorporated in the analysis.

To project National loadings for domestic sources, representative pollutant concentrations were scaledup for the portion of National flow that can be attributed to residential and commercial sources. According to the EPA NEEDS Survey, 4.4 BGD, or 17 percent, of the total National flow of 26 BGD represents industrial flow. The remainder, 21.6 BGD in flow, is assumed to be residential and commercial flow.(30)

Table 3-31 estimates National loadings and percent contribution from domestic sources. To determine percent contribution, domestic loadings are compared both with projected National POTW influent loadings based on 40 POTW Study data and with estimates of the POTW industry loadings for selected consent decree industries presented in Section 3.3 of this chapter. The table shows projected domestic loadings of 5,563 kkg/yr and 2,633 kkg/yr for hazardous metals* and priority organics, respectively. When compared with projected POTW influent loadings, metal and organic loadings from domestic

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*For the purposes of this discussion, the term "metals" should be interpreted to include cyanide.

TABLE 3-31. RESIDENTIAL CONTRIBUTION TO OVERALL POTW INFLUENT CONSTITUENT LOADINGS

	Projected National Residential Loadings, (kkg/yr)[1]	Projected National POTW Influent Loadings[2] kkg/yr	Percent Residential Contribution Based on POTW Influent Loadings (%)	Projected Cumulative Industrial and Residential Loadings - Raw Discharge[3] (kkg/yr)	Percent Residential Contribution Based on Cumulative Loadings - Raw Discharge (%)	Projected Cumulative Industrial and Residential Loadings - PSES Discharge[4] (kkg/yr)	Percent Residential Contribution Based on Cumulative Loadings - PSES Discharge (%)
Total Hazardous Organic Constituents - Priority Only	2,633	35,002	7.5	40,056	6.5	22,349	11.8
Total Hazardous Metals (+Cn)	5,563	28,717	19.4	67,974	8.2	8,833	63.0

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[1] Calculation assumes 21.6 BGD residential flow out of a total National POTW flow of 26 BGD. Flow values are derived from the 1980 NEEDS Survey.

[2] For organic constituents, calculations are based on scale-up of flow-weighted average concentrations, excluding POTW #28.

[3] Estimate represents the sum of projected industrial loadings (raw discharge) and residential loadings.

[4] Estimate represents the sum of projected industrial loadings (PSES discharge) and residential loadings.

sources account for 7.5 and 19.4 percent, respectively, of loadings to POTWs. The analysis demonstrates that domestic sources do contribute both metal and organic hazardous constituents to POTWs. As presented in Table 3-31, the comparison of domestic loadings with industrial loadings for raw and PSES discharge scenarios demonstrates that the relative contribution of domestic sources to overall loadings should increase as categorical standards are implemented. Because PSES implementation will result in substantial control of metals discharges by industrial sources, the domestic contribution of hazardous metals is projected to increase from 8.2 to 63.0 percent of total metals loadings. The principal hazardous metals in domestic wastewaters are lead, chromium, cyanide, and nickel. Major organic constituents found in domestic wastewater include chlorinated solvents (e.g., tetrachloroethylene, trichloroethylene), aromatic hydrocarbons (e.g., toluene) and phthalate esters [e.g., Bis(2-ethyl hexyl) phthalate].

3.7 SUMMARY

This section summarizes the types, quantities, and sources of hazardous wastes discharged to POTWs.

3.7.1 Types, Sources, and Quantities of Hazardous Constituent Loadings to POTWs

As discussed in the introduction to Chapter 3, quantities of characteristic and listed hazardous waste discharged cannot be determined for the consent decree industries (except the organics industries) due to limitations in existing data sources. As a result, the Agency has estimated loadings of metal and organic hazardous constituents from the 30 selected consent decree industries. Although loadings estimates generally are limited to priority hazardous constituents, the scope of the EPA/OSW ISDB also allows estimation of nonpriority hazardous constituent loadings and hazardous waste loadings from the organics industries. For the 17 remaining industrial categories, EPA has utilized a variety of data sources to assess the potential for discharge of hazardous wastes by these categories.

In evaluating consitutent loadings, the Agency projected national industrial loadings using ITD and ISDB data sources and national constituent loadings to POTW influents. Generally, POTW and industrial constituent loadings show reasonable agreement. For organic constituents, an analysis of the 40 POTW data base results in projected national loadings of between 35,000 and 71,000 metric tons of priority organics. Estimates for total industry raw loadings of priority organics range from 37,000 metric tons to 52,000 metric tons per year, depending on whether ITD or ISDB loadings are used. For metal constituents, industry estimates for raw loadings (62,000 kkg/yr) based on ITD loadings exceed projected POTW loadings (29,000 kkg/yr) based on 40 POTW sampling data. The difference may reflect the degree to which pretreatment programs have reduced levels from raw to current.

Table 3-32 provides estimates of the quantities of hazardous constituents discharged to POTWs from the selected consent decree industrial categories under the raw and PSES scenarios. Hazardous constituents (both priority and nonpriority) also are broken out into two major groups of constituents: metals (including cyanide) and organics.

Approximately 62,000 metric tons per year of hazardous metal constituents are discharged to POTWs under the raw loadings scenario. These loadings of hazardous metal constituents for the consent decree industries are estimated to be reduced by approximately 95 percent after implementation of pretreatment standards for the applicable industrial categories. This reduction results in a PSES loading for hazardous metal constituents of 3,270 metric tons per year.

The major industrial source of priority hazardous metal constituents under the raw loading scenario is the electroplating/metal finishing category, which accounts for approximately 68 percent of the total metals loading. Electroplating/metal finishing is also the major source of priority hazardous metal constituents under the after PSES scenario. Other major sources under the after PSES scenario include laundries (15 percent of total metal loadings), petroleum refining (15 percent), and leather tanning categories (12 percent).

For priority hazardous organic constituents, Table 3-32 shows that between 37,000 and 52,000 metric tons per year are discharged to POTWs under

TABLE 3-32. SUMMARY OF HAZARDOUS CONSTITUENT LOADINGS TO POTWs FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES*

Industry Category	Estimated Number of Indirect Dischargers	Priority Hazardous Constituents				Nonpriority Hazardous Constituents				Total Hazardous Constituents			
		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)	
		Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics
Adhesives and Sealants	298	289	97	131	70	ND	ND	ND	ND	289	97	131	70
Battery Manufacturing	149	1,509	<1	1	<1	ND	ND	ND	ND	1,509	<1	1	<1
Coal, Oil, Petroleum Products and Refining	45	484	1,686	484	1,686	ND	ND	ND	ND	484	1,686	484	1,686
Dye Manufacturing and Formulation	47	(428) 279	(434) 206	(1) <1	(1) <1	(2) ND	(11,400) ND	(2) ND	(136) ND	(431) 279	(11,834) 206	(3) <1	(136) <1
Electrical and Electronic Components	270	158	315	74	32	ND	ND	ND	ND	158	315	74	32
Electroplating/ Metal Finishing	10,561	42,339	3,631	1,017	175	ND	ND	ND	ND	42,339	3,631	1,017	175
Equipment Manufacture and Assembly	ND	ND	7,715	ND	7,715	ND	ND	ND	ND	ND	7,715	ND	7,715
Explosives Manufacture	4	<1	<1	<1	<1	ND	ND	ND	ND	<1	<1	<1	<1
Gum and Wood Chem., and Related Oils	14	2	51	2	51	ND	ND	ND	ND	2	51	2	51
Industrial and Commercial Laundries	68,535	595	984	502	984	ND	ND	ND	ND	595	984	502	984
Ink Manufacture and Formulation	223	3	<1	3	<1	ND	ND	ND	ND	3	<1	3	<1
Inorganic Chemicals Manufacturing	31	1,053	0	103	0	ND	ND	ND	ND	1,053	0	103	0

TABLE 3-32. SUMMARY OF HAZARDOUS CONSTITUENT LOADINGS TO POTWs FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES* (Continued)

Industry Category	Estimated Number of Indirect Dischargers	Priority Hazardous Constituents				Nonpriority Hazardous Constituents				Total Hazardous Constituents			
		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)	
		Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics
Iron and Steel Mfg. and Forming	162	3,920	2,715	97	236	ND	ND	ND	ND	3,920	2,715	97	236
Leather Tanning and Finishing	140	5,097	210	375	164	ND	ND	ND	ND	5,097	210	375	164
Nonferrous Metals Forming	228	203	ND	2	ND	ND	ND	ND	ND	203	ND	2	ND
Nonferrous Metals Manufacturing	123	114	9	1	1	ND	ND	ND	ND	114	9	1	1
Organic Chemicals Manufacturing	230	(5,251) 1,021	(15,931) 6,067	(515) 5	(846) 6	(730) ND	(13,918) ND	(37) ND	(996) ND	(5,982) 1,021	(29,849) 6,067	(552) 5	(1,842) 6
Paint Manufacture and Formulation	751	17	49	15	42	ND	ND	ND	ND	17	49	15	42
Pesticides Formulation	169	ND	ND	0	0	ND	ND	ND	ND	ND	ND	0	0
Pesticides Manufacture	38	(232) 3	(536) 2,852	(2) <1	(<1) <1	(1) ND	(28,055) ND	(<1) ND	(533) ND	(233) 3	(28,591) 2,852	(2) <1	(535) <1
Pharmaceutical Manufacturing	277	4,563	7,369	35	7,369	ND	ND	ND	ND	4,563	7,369	35	7,369
Photographic Chem. and Film Mfg.	ND	184	5	66	4	ND	ND	ND	ND	184	5	66	4
Plastics Molding and Forming	1,145	9	19	9	19	ND	ND	ND	ND	9	19	9	19
Plastics, Resins and Synthetic Fibers Mfg.	153	(118) 53	(8,514) 2,200	(7) 2	(10) 1	(3) ND	(10,188) ND	(2) ND	(865) ND	(120) 53	(18,702) 2,200	(9) 2	(875) 1
Porcelain Enameling	88	177	1	17	<1	ND	ND	ND	ND	177	1	17	<1
Printing and Publishing	38,679	155	17	145	16	ND	ND	ND	ND	155	17	145	16

TABLE 3-32. SUMMARY OF HAZARDOUS CONSTITUENT LOADINGS TO POTWs FOR THE SELECTED CONSENT DECREE INDUSTRIAL CATEGORIES* (Continued)

Industry Category	Estimated Number of Indirect Dischargers	Priority Hazardous Constituents				Nonpriority Hazardous Constituents				Total Hazardous Constituents			
		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)		Raw Loading (kkg/yr)		After PSES Loading (kkg/yr)	
		Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics	Metals/CN	Organics
Pulp and Paper Mills	261	100	806	100	749	ND	ND	ND	ND	100	806	100	749
Rubber Manufacture and Processing	512	2	15	2	15	ND	ND	ND	ND	2	15	2	15
Textile Mills	974	79	370	79	370	ND	ND	ND	ND	79	370	79	370
Timber Products Processing	6,680	3	34	3	11	ND	ND	ND	ND	3	34	3	11
SUBTOTALS**	130,787	(67,084) 62,411	(51,513) 37,423	(3,788) 3,270	(20,566) 19,716	(736) ND	(63,561) ND	(41) ND	(2,530) ND	(67,821) 62,411	(115,074) 37,423	(3,829) 3,270	(23,091) 19,716
Projected Residential Loadings	ND	5,563	2,633	5,563	2,633	ND	ND	ND	ND	5,563	2,633	5,563	2,633
TOTALS**	130,787	(72,647) 67,974	(54,146) 40,056	(9,351) 8,833	(23,199) 22,349	(736) ND	(63,561) ND	(41) ND	(2,530) ND	(73,384) 67,974	(117,707) 40,056	(9,392) 8,833	(25,724) 22,349

ND - No Data

* - Data shown in parentheses represent estimates from the OSW ISDB for each applicable industrial category.

** - Totals and subtotals calculated with ISDB values for applicable industrial categories (shown in parentheses) and with ITD data (shown without parentheses). ND or less than one (<1) values were assumed to be zero.

the raw loadings scenario from all the selected consent decree industrial categories. These priority hazardous organic constituent raw loadings are reduced overall by approximately 50 percent after the implementation of pretreatment standards by applicable industrial categories. The total priority hazardous organic constituent loadings after PSES are approximately 20,000 metric tons per year.

As shown in Table 3-32, several industrial categories contribute significant quantities of priority hazardous organics to POTWs under the raw loading scenario. These industrial categories include equipment manufacture and assembly; organic chemicals manufacture; pharmaceutical manufacture; electroplating/metal finishing; and plastics, resins, and synthetic fibers manufacturing. The source profile for loadings of priority hazardous organic constituents changes significantly after PSES implementation to exclude those industrial categories regulated under categorical standards for priority organics. As a result of PSES implementation, several industrial categories currently not regulated for priority organics under categorical standards become major sources of priority hazardous organic constituents. These industrial categories include equipment manufacture, pharmaceutical manufacture, petroleum refining, and industrial and commercial laundries.

Table 3-32 presents estimated loadings of nonpriority hazardous constituents to POTWs from the organics industries. As described in Section 3.2, these nonpriority hazardous constituent loadings were developed utilizing ISDB data for four organic chemicals industrial categories. Raw loadings to POTWs of nonpriority hazardous constituents for these four organic chemical industrial categories are estimated to be 64,000 metric tons per year, of which only 736 metric tons include nonpriority hazardous metals. Based on these estimates, the organics industries discharge wastewater containing over 2 kilograms of nonpriority organic constituents for each kilogram of priority organic constituents. Incidental removals due to installation of a PSES technology equivalent to an acclimated biological system and assuming removal rates presented in Chapter 4 are obtained, an overall reduction of 95 percent in loadings of the nonpriority hazardous organic constituents would be obtained. Where those assumptions are not met, these reduction estimates may be substantially overstated.

Loadings of nonpriority hazardous constituents also may be significant for remaining consent decree industrial categories. Although loadings data on the discharge of nonpriority hazardous constituents to POTWs are not available, the presence of these nonpriority hazardous constituents in discharges to POTWs has been documented extensively in various data sources for several selected consent decree industrial categories, such as pharmaceutical manufacturing, paint manufacture and formulation, equipment manufacture and assembly, and electrical and electronic equipment. POTW loadings projections outlined in Section 3.5 and POTW influent data collected for this study also support the conclusion that certain nonpriority organic constituents are discharged to POTWs in significant quantities.

For the remaining 17 industrial categories (discussed in Section 3.4), Table 3-33 presents types and quantities of hazardous wastes discharged to POTWs. These data were extracted from the SQG survey, which contains data for only 12 of these 17 industrial categories.(5) For these 12 industrial categories, it was estimated that a total of 28,294 metric tons of hazardous wastes are discharged annually to POTWs. The industrial category discharging the largest quantity of hazardous wastes to POTWs is the service-related industry, which encompasses a wide range of facilities providing various services (e.g., photographic processing, extermination services) to the public sector. Three of the five industrial categories lacking hazardous waste or constituent discharge data represent new, emerging industries. These industrial categories are hazardous waste site cleanup, waste reclamation services, and waste treatment and disposal. Based on assessments of the limited data available, facilities within these categories are already causing site-specific problems and may represent a significant source of hazardous waste discharges at the National level as well.

To project quantities of hazardous constituents discharged to POTWs by domestic sources, an estimate of residential loadings of priority hazardous constituents was developed in Section 3.6. As shown in Table 3-32, residential loadings of hazardous constituents account for 5,563 metric tons of priority hazardous metal consitituents and 2,633 metric tons of priority

TABLE 3-33. QUANTITIES OF HAZARDOUS WASTETYPES DISCHARGED TO POTWs FROM SMALL QUANTITY GENERATORS FOR OTHER INDUSTRIAL CATEGORIES

Industrial Category	Spent Solvents (kg/yr)	Ignitable Wastes (kg/yr)	Strong Acid or Alkaline Wastes (kg/yr)	Photographic Wastes (kg/yr)	Pesticides Wastes (kg/yr)	Reactive Wastes (kg/yr)	Other Wastes (kg/yr)	Total (kg/yr)
Construction Industry	8,592	215,028	18,468	0	0	0	0	242,088
Cosmetics, Frags., Flavors & Food Add.	3,708	19,572	40,740	0	5,940	0	0	69,960
Elec. Gen. Power Plants & Elec. Dist.	ND	ND	ND	ND	ND	ND	ND	ND
Fertilizer Manufacture	0	0	22,560	0	0	0	12	22,572
Food and Food By-Products Processing	ND	ND	ND	ND	ND	ND	ND	ND
Hazardous Waste Site Cleanup	ND	ND	ND	ND	ND	ND	ND	ND
Laboratories and Hospitals	1,005,204	455,388	329,196	0	0	309,672	204	2,099,644
Miscellaneous Chemical Formulations	49,488	1,128	112,056	0	17,808	7,836	0	188,316
Motor Vehicle Services	1,151,544	8,376	158,940	0	0	0	0	1,318,860
Service Related Industries	577,488	214,092	339,864	18,457,452	670,764	14,244	2,872,164	23,146,068
Soaps & Detergents, Manufacture & Form.	28,560	9,696	266,904	0	315,936	0	72	621,168
Stone, Clay, Glass, and Other Products	0	0	0	0	0	0	0	0
Transportation Services	26,436	0	0	0	0	0	0	26,436

TABLE 3-33. QUANTITIES OF HAZARDOUS WASTETYPES DISCHARGED TO POTWs FROM SMALL QUANTITY GENERATORS FOR OTHER INDUSTRIAL CATEGORIES (Continued)

Industrial Category	Spent Solvents (kg/yr)	Ignitable Wastes (kg/yr)	Strong Acid or Alkaline Wastes (kg/yr)	Photographic Wastes (kg/yr)	Pesticides Wastes (kg/yr)	Reactive Wastes (kg/yr)	Other Wastes (kg/yr)	Total (kg/yr)
Waste Reclamation Services	ND	ND	ND	ND	ND	ND	ND	ND
Waste Treatment and Disposal	ND	ND	ND	ND	ND	ND	ND	ND
Wholesale and Retail Trade	32,256	49,728	132	30,912	22,884	0	24,108	160,020
Wood Furniture Mfg. and Refinishing	151,488	11,268	0	0	0	0	236,940	399,696
TOTALS	3,034,764	984,276	1,288,860	18,488,364	1,033,332	331,752	3,133,500	28,294,848

ND-No Data

SOURCE: Reference (5)

hazardous organic constituents discharged annually. This analysis demonstrates that domestic sources do contribute hazardous constituent loadings to POTWs. The relative contribution of constituent loadings by domestic sources should increase significantly with PSES implementation.

3.7.2 Analysis of Hazardous Waste Types Discharged to POTWs

Due to the types of data available, Agency review has emphasized industry loadings of specific hazardous constituents, rather than wastes. Still, constituents loadings data and other data collected and evaluated for this study also enable EPA to examine the potential for discharge of characteristic and listed wastes by various industrial sources. This section provides a brief summary of Chapter 3 industrial data as it relates to the discharge of hazardous wastes. RCRA characteristic wastes include ignitable, corrosive, reactive, and EP toxic wastes. Each of those waste types is evaluated below.

The Chapter 3 analysis of volatile and ignitable constituents demonstrates that numerous industrial categories discharge wastewaters containing significant quantities of ignitable constituents. When discharged in substantial concentrations, these organic constituents, especially volatile organics such as benzene, toluene, and xylene, may cause fire or explosion in POTW collection and treatment systems. The POTW incidents file (Appendix K) documents several discharges of ignitable wastes that have caused fire or explosions in POTW systems.

The industry assessment similarly indicates that a broad range of industries may generate and discharge corrosive or reactive wastes to POTWs. An extensive review of ITD development documents reveals that numerous consent decree industrial categories generate highly acidic or alkaline wastewaters. Moreover, as estimated by the SQG Survey, a majority of the remaining categories also generate and discharge to POTWs strong acid or alkaline wastes. Based on a review of ITD data, many industry wastestreams contain waste constituents such as cyanide and sulfides that have reactive properties. Discharges of reactive wastes also are documented in the POTW incidents file.

Analysis of loadings of specific hazardous metals constituents reveals that most of the selected consent decree industries discharge some quantity of the EP toxic metal constituents in their wastewaters. Table 3-34 presents an overview of major industrial sources of each EP toxic metal contaminant. Table 3-34 does not provide estimates of hazardous waste quantities, but rather shows the principal metal constituents in industry wastewaters, and the extent of PSES controls on these constituents by comparing industry-wide constituents concentrations (i.e., total industry mass loadings divided by total industry flow) to EP toxic contaminant concentrations in RCRA regulations. Table 3-34 demonstrates that categorical standards result in substantial control of EP toxic metals discharged by consent decree industries. Some regulatory gaps remain for smaller sources, such as laundries and printing/publishing operations.

The Agency has listed numerous wastes based on the presence in these wastes of specific constituents that are either toxic or possess a characteristic such as ignitability. Evaluation of the potential for discharge of these wastes therefore may be tied to specific constituents that are likely to be present in these wastes. The following discussion emphasizes selected listed wastes including spent solvents, listed wastes for the metal finishing industry, and listed wastes for the organics industries.

Sampling and use data collected for the industry assessment suggest that numerous industrial categories discharge spent solvents. Table 3-35 demonstrates the range of industries known or believed to discharge the 26 organic constituents listed as spent solvents. Although actual sampling data for the 16 nonpriority pollutants are limited, several of these compounds (e.g., acetone, xylene, cresols, etc.) appear to find prevalent use among the consent decree industries. The POTW incidents file also documents operational problems associated with the discharge of these solvents, especially volatile, ignitable compounds.

Appendix VII constituents for metal finishing wastes include hexavalent chromium, nickel, cadmium and cyanide. Because these four waste constituents are regulated specifically by categorical standards, pretreatment controls

TABLE 3-34. COMPARISON OF INDUSTRY-WIDE METAL CONCENTRATIONS WITH MAXIMUM EP CONTAMINANT CONCENTRATIONS[1]

EP Toxic Contaminant[1] / Industrial Category	Adhesives and Sealants	Battery Manufacturing	Dyes and Pigments	Electrical/ Electronics	Electroplating/ Metal Finishing	Industrial/ Commercial Laundries	Ink Formulation	Inorganic Chemicals	Iron and Steel	Leather Tanning	Nonferrous Forming	Organic Chemicals	Plastics and Resins	Paint Formulation	Pesticide Manufacture	Petroleum Refining	Photographic Chemicals	Porcelain Enameling	Printing and Publishing	Timber Products
Arsenic (Maximum EP Conc. = 5.0 mg/l)				Raw >1 PSES/* 0																Raw >.1 PSES/* >.1
Cadmium (Maximum EP Conc. = 1.0 mg/l)		Raw >.25 PSES/* 0			Raw >.25 PSES/* 0			Raw >1 PSES/* >.25						Raw >.25 PSES >.25			Raw >1 PSES >1	Raw >1 PSES >.1	Raw >.25 PSES >.25	
Chromium (Maximum EP Conc. = 5.0 mg/l)	Raw >1 PSES >1		Raw >1 PSES 0		Raw >1 PSES/* >.1		Raw >.1 PSES >.1	Raw >1 PSES/* >.25	Raw >.25 PSES/* 0	Raw >1 PSES/* >1	Raw >.25 PSES/* 0	Raw >.1 PSES 0	Raw >1 PSES >0	Raw >1 PSES >1	Raw >1 PSES >1	Raw >.1 PSES >.1	Raw >.25 PSES >.25			Raw >.1 PSES/* >.1
Lead (Maximum EP Conc. - 5.0 mg/l)		Raw >1 PSES/* 0	Raw >1 PSES 0	Raw >.25 PSES/* 0		Raw >.1 PSES >.1	Raw >.25 PSES >.25	Raw >1 PSES/* >.1	Raw >.25 PSES/* 0	Raw >1 PSES >1		Raw >.25 PSES/* >0		Raw >1 PSES >1				Raw >1 PSES/* >.1	Raw >.1 PSES >.1	
Mercury (Maximum EP Conc. - 0.2 mg/l)								Raw >1 PSES/* 0						Raw >1 PSES >1			Raw >.1 PSES >.1			Raw >.1 PSES >.1
Selenium (Maximum EP Conc. = 1.0 mg/l)												Raw >.25 PSES/* 0				Raw >.1 PSES >.1		Raw >1 PSES >.1		
Silver (Maximum EP Conc. = 5.0 mg/l)																	Raw >1 PSES >1			

KEY:

Conc. Ratio at Raw Discharge
Conc. Ratio at PSES Discharge

>1 = Industry-wide concentration greater than 100% of EP maximum contaminant concentration
>.25 = Industry-wide concentration greater than 25% of EP maximum contaminant concentration
>.1 = Industry-wide concentration greater than 10% of EP maximum contaminant concentration
0 = Industry-wide concentration less than 10% of EP maximum contaminant concentration

* = Pollutant specifically regulated by a categorical standard

[1] Table does not provide estimates of hazardous waste quantities. Rather, it is intended to show principal metal constituents in industry wastewaters, and extent of PSES controls on these constituents.

Barium is not included due to lack of sampling data

TABLE 3-35. PROFILE OF INDUSTRIAL SOURCES OF ORGANIC CONSTITUENTS WHICH ARE RCRA SPENT SOLVENTS

ORGANIC CONSTITUENTS LISTED AS SPENT SOLVENTS / INDUSTRIAL CATEGORY	Adhesives and Sealants	Petroleum Refining	Construction Industry	Dye Manufacture	Electrical/Electronic*	Electroplating/Metal Finishing*	Equipment Manufacture	Gum and Wood Chemicals	Industrial/Commercial Laundries	Ink Manufacture	Laboratories and Hospitals	Leather Tanning and Finishing	Motor Vehicle Services	Organic Chemicals	Paint Manufacture	Pesticides Manufacture	Pesticides Formulation	Pharmaceutical	Plastics Molding	Plastics, Resins	Printing and Publishing	Rubber Manufacture	Textile Mills	Transportation Services	Waste Reclamation Services	Waste Treatment and Disposal	Wood Furniture Manufacture
Acetone					P	P	P		P	P	P	P		420	P	6702	P	P	P	1	P		P		P	P	P
N-Butyl Alcohol				1	P		P		P	P		P		6	P			P		<1	S				P	P	
Carbon Disulfide										P		P		P	P	P	P		P	P					P		
Carbon Tetrachloride	<1					1			9		P			16	<1	2	<1	4		1	<1			P		P	
Chlorobenzene	<1	<1				<1				<1		<1	S	1	<1	306	P	P		P			S	P	P	P	P
Cresols	P	P			P	35	P		P	P	S	P		P	P			P	P	P			P	P	P	P	S
Cyclohexanone						P			P					581					P	1							
Dichlorodifluoromethane											S							S	S							P	
1,2-Dichlorobenzene	<1				6	P	P		6			6	S	<1		4		1		P	S		2	P		P	S
Ethyl Acetate				50	P		P			P				P	P	12		P	P	P	P				P	P	
Ethyl Benzene	<1	323	S		<1	<1	S	23	199	<1	P	4	S	112	14	P	<1	140	<1	7	2	1	130	P	P	P	
Ethyl Ether					P					P	S			P	P			P		P	P					P	
Isobutanol		P			P					P				P	P	P	P	P	P	P	P						P
Methanol				8,692			S				S		S	1,900	P	7103	P	P		113				P			P
Methylene Chloride	9	<1			2	3	535	7	14	<1	P	<1	S	4	12	22	<1	4,700	2	<1	2		27	P	P	P	P
Methyl Ethyl Ketone	P	P			P	P	P		P	P		P	S	1	P	P	P	P		1	P				P	P	S
Methyl Isobutyl Ketone	S				P		P			P	S			1,640	P			S	P	P	P					P	S
Nitrobenzene						<1						9		49	<1					<1							
Pyridine										P				23	P			P					S				
Tetrachloroethylene	<1	<1			11	6	1,299		31	<1		2		<1	<1		<1	1	P				29	P	P	P	S
Toluene	5	790	S	2	<1	1	299	12	70	<1	P	3	S	300	14	364	P	700	<1	31	2	14	30	P	P	P	P
1,1,1-Trichloroethane	3	<1			6	18	3,019	<1	36	<1	P	<1		<1	<1	P	10	8	2	<1	<1		13	P	P	P	
Trichloroethylene	<1			<1	1	8	1,681		3	<1		<1		5	<1	P	P	3	<1	<1	1		20	P	P	P	
Trichlorofluoromethane									<1																	P	
1,1,2-Trichloro-1,2,2-Trifluoroethane					S		P								P	P	P		P				P				
Xylenes	S	P	S		P	S	P		P	P	P		S	31	P	13,761	P	P	P	P	P		P	S	P	P	S

(All loadings are in metric tons/year)

Key:
- ● Loadings reflect current loadings based on ITD or 1500 data
- ● P = Constituent identified based on review of Paragraph 4c sampling data, DSS sampling data or State/local sampling data
- ● S = Constituent believed to be present in industry wastewater based on review of Chapter 3 use profile data, SQG data or HWDMS data base.

* Loadings for these categories reflect PSES organics controls (e.g., TTO). Raw loadings may be significantly higher than PSES loadings.

Sources: References (5), (6), Appendix I

CHAPTER 4

FATE OF HAZARDOUS WASTE AND POLLUTANTS IN POTW COLLECTION AND TREATMENT SYSTEMS

4. FATE OF HAZARDOUS WASTE AND POLLUTANTS IN POTW COLLECTION AND TREATMENT SYSTEMS

4.1 BACKGROUND AND METHODOLOGY

Projected POTW influent loadings of DSS pollutants were discussed in Chapter 3. The purpose of this chapter is to analyze the fate of these pollutants once they are discharged to POTW collection/treatment systems. As discussed in Chapter 2, 165 pollutants were selected to represent the hazardous constituents being discharged to POTWs. Of these pollutants, 10 are metals, 38 are pesticides, and 117 are organic pollutants. The physical/chemical properties utilized in assessing the fate of each of these pollutants are presented in Appendix N.

A POTW collection/treatment system is composed of three components: (1) a conveyance system of underground sewer pipes that collect and transport wastewater to a treatment facility; (2) the treatment plant, which consists of various unit processes designed to remove pollutants from the wastewater; and (3) an outfall structure, which discharges treated effluent to a receiving body of water. Pollutants can be removed from the wastewater and/or transferred to other media through five pathways:

- Leaks in the collection system
- Volatilization to the atmosphere
- Biodegradation of pollutants
- Partitioning of pollutants to sludge
- Treatment plant pass through of pollutants to the receiving stream.

The determination of the fate of pollutants within these pathways is dependent upon a number of complex and interrelated factors. These factors include the design of the POTW collection/treatment system, how the system is operated and maintained, the physical/chemical properties of the pollutants, and the physical/chemical properties of the total wastestream. These factors are highly site-specific and will vary among POTWs. Data generally are not available to characterize each of these factors to the level of detail necessary for a rigorous analysis. However, based on literature information and recent EPA research, reliable estimates can be made.

In searching the literature for information on the fate of DSS pollutants in POTW sewers and collection systems, it was discovered that little is known about DSS pollutant fate and behavior in POTW collection systems. Most of the research and sampling study work has focused on pollutant concentrations, either at the discharge point of specific industrial contributors or at the POTW. In addition, lack of available data on ground-water contamination due to leaking POTW collection systems makes it difficult to estimate the extent of this problem.

Considerably more research has been conducted on the removability and probable fate of DSS pollutants in POTW treatment plants. The portion of these pollutants not present in a POTW effluent are removed by three principal mechanisms: partitioning (sorption) to the solids and biomass, stripping and desorption of volatile organics, and biodegradation of specific pollutants. These three removal mechanisms in conventional wastewater treatment (i.e., primary-activated sludge) interact and complement each other in reducing emissions to the receiving stream. Prediction of the removability and fate of a given pollutant requires knowledge of the equilibrium and kinetic rates of each mechanism.

Detailed data are limited, especially for kinetic rates. For the purposes of estimating the removability and fate of the DSS pollutants and projecting these loadings on a National basis, this study used the results of recent research conducted by a toxics research group at EPA's Wastewater Environmental Research Laboratory (WERL) in Cincinnati, Ohio. This work was selected as the basis for the derivation of emission factors because it represented a collective opinion of several individuals with experience in the field(1,2,3,4).

EPA-WERL based their conclusions on probable fate on their best professional judgments (BPJ), and summarized literature data, their collective knowledge of biodegradation literature, their "hands on" pilot experience with pertinent DSS pollutant removability, and their experience with ongoing treatability studies. They utilized Henry's Law Constants, octanol/water partition coefficients, and qualitative biodegradation data in making the estimates.

The volatility parameter for DSS pollutants must consider the substance's tendency to vaporize and its propensity to remain in solution. The principal measure that has been used in the literature is Henry's Law Constant. Henry's Law Constants are available or can be calculated from information available in the literature for the majority of the DSS pollutants.

The Henry's Law Constant is a ratio of a substance's vapor pressure and solubility. It measures a compound's tendency to partition between the aqueous and gaseous phases at equilibrium. The higher a substance's Henry's Law Constant, the more likely that compound is to migrate from water to air. Henry's Law Constants are presented in the literature in various manners and with various units. The most common formula given for Henry's Law Constant and the one used in the estimates in this chapter is:

$$H = \frac{Pv}{Cs}$$

where: H = Henry's Law Constant (at equilibrium) $\frac{\text{atm-m3}}{\text{mole}}$

Pv = Compound's vapor pressure in air (atm)

Cs = Compound's soluble concentration in water (mole/m3).

The octanol/water partition coefficient (K_{ow}) is a measure of a compound's tendency to concentrate either in the organic phases or in water at equilibrium. In general, the higher a compound's K_{ow}, the more likely that compound will be to migrate from the aqueous phase and partition. Therefore, compounds with high K_{ow} values would be expected to adsorb more readily to the biomass during activated sludge treatment.(5)

4.1.1 Summary of Current State of Knowledge on Pollutant Fate

Among the organic pollutants, the literature supports the contention that there are three dominant processes ongoing at the same time within treatment facilities causing the removal of pollutants from wastewater: (1) air stripping and desorption; (2) sorption to solids or the biomass; and (3) biodegradation. The extent to which each process contributes to the removal of pollutants from wastewater during treatment can vary significantly. It is a function of both the physical and chemical characteristics of each pollutant, as well as the conditions present in the particular treatment facility, such as the relative rate of aeration (which is governed by the rate of oxygen/air flow), total area of the air/liquid interface, and the concentration and activity of the mixed liquor volatile suspended solids (MLVSS). These processes, as well as the conditions present throughout the treatment process, will be discussed further below. Other removal mechanisms, such as hydrolysis or photo-oxidation, may potentially play some role in the removal of a specific pollutant; however, no discussion of these mechanisms appeared in the literature. Recent studies have shown that the degree of acclimation of a biological treatment system plays an important role in the fate of DSS pollutants. Acclimated removals occur under conditions when a biological treatment system has been fed relatively steady amounts of a pollutant and biodegradation rates stabilize.

Partitioning (Adsorption)

The literature and research performed to date support the existence of a direct relationship between a compound's water insolubility or hydrophobicity and its affinity for the surface area and extent of surface area available in the sorbent. A widely used tool for estimating insolubility and subsequent potential for sorption of organic compounds onto particulates and biomass is the K_{ow}, or the octanol/water partition coefficient. K_{ow} often is expressed as a logarithm to the base 10, or Log K_{ow}. In general, compounds that have Log K_{ow} values greater than 3.5 are significantly hydrophobic and adsorptive on solid organic matter, such as MLVSS or sludge. Compounds that have Log K_{ow} less than 3.5 more likely will be removed through biodegradation or, in the case of a more volatile pollutant, through air stripping. Due to their adsorptive nature, compounds having a high Log K_{ow} also may be expected to concentrate in sludge. This expectation has been confirmed in at least one recent study(6) that found a reasonably good correlation between primary sludge concentration factors (computed by dividing the concentrations in the primary sludge by the influent concentrations) and K_{ow}. This study also found that, while substantial losses of volatile organic compounds during primary clarification are due to volatilization, partitioning to the primary sludge was not the primary removal mechanism since the concentrations in the primary sludge were low. Additional factors that may affect the rate of adsorption include the presence of other compounds, electrolytes, oils and greases, and sorbents.

Volatilization

Pollutants are stripped from aeration basins in activated sludge systems by diffusing through the surface of air bubbles used to aerate the system. In addition, flumes, grit chambers, sumps, equalization basins, pH adjustment stations, nutrient addition stations, clarifiers, oxidation basins, open storage tanks, wastewater transfer lines, pipes, or ditches are all points where volatilization can occur. In a 1984 field study of a wastewater treatment system at an organic chemicals facility, 10-15 percent of influent toluene volatilized in the primary system, 25-35 percent volatilized in the equalization basins, and 10-34 percent volatilized from the aeration basins.(14) A pollutant's ability to transfer into the air bubbles or desorb from water surfaces is functionally dependent on its Henry's Law Constant (HC). Compounds with high HC values (greater than 0.024) have been shown in the literature to be easily stripped. According to one study,(7) the air stripping rate of a specific organic is also influenced by the concentration of that contaminant in the liquid being aerated. In addition, a pollutant's affinity to adsorb onto the biomass is a mechanism that will reduce the amount of material stripped during conventional treatment. It also has been shown that stripping is most likely to be the dominant removal mechanism for many halogenated compounds. The more halogenated a chemical compound is by weight, the more it is likely that the compound will be removed by stripping. This contention is confirmed by the high rates of volatilization (greater than 90 percent) that have been reported in POTWs for VOCs such as 1,1,1-trichloroethane, trichlorofluoromethane, and dichlorodifluoromethane. In comparison, lower volatilization rates have been reported for nonhalogenated pollutants such as benzene and toluene.(6)

Biodegradation

Biodegradation plays a substantial and sometimes controlling role in the ultimate fate of the volatile organics, especially those of moderate volatility in conventional wastewater treatment. The extent of biological oxidation depends on the ease of biodegradation of the compound, availability of co-metabolites serving as food to the biota, the quantity (concentration) of biologically active solids (MLVSS) and oxygen, as well as the degree of acclimation of the MLVSS.

As was discovered in one study,(8) the rate of biodegradation often is controlled by the availability of oxygen. In a well-aerated system, for compounds such as benzene and toluene that biodegrade to some degree under normal aeration conditions, air stripping may be the dominant removal mechanism. The extent of halogenation also influences the relative biodegradability of the compound (i.e., the more halogens in a chemical compound by weight, the less biodegradation will be in evidence). Biochemical oxidation is highest for organic priority pollutants having low Log K_{ow} values (less than 3.5). In addition, air stripping has been shown to compete with biodegradation as a removal mechanism in activated sludge treatment for some compounds such as benzene, toluene, ethylbenzene, and chlorobenzene that have relatively high Henry's Law Constants.(7)

Among the three mechanisms discussed above, the dominant removal route at any one time will depend on the relative rates of aeration. The removal mechanisms are affected critically by the plant design and flow, air to liquid rates, and the concentration and activity of MLVSS. All of these factors are critically dependent on how well the facility is run and the distribution, characteristics, and concentrations of the pollutants in the wastewater. In acclimated treatment systems, biodegradation is a more effective removal mechanism. In unacclimated treatment systems, removal of many organics is chiefly by volatilization and sorption to solids and biomass.(1) Dissolved salts also affect all three removal mechanisms associated with activated sludge treatment systems. Such factors as surface tension, interfacial tension, viscosity, and diffusion also must be considered in ultimate environmental fate analysis.(7) Design of the aeration basin is also a critical factor that affects removal mechanisms.

4.1.2 Summary of Findings on Pollutant Fate

Volatile Organic Compounds (VOCs)

There is mounting evidence that many of the DSS pollutants only have limited survival times under commonly encountered conditions. A large percentage of the VOC mass is not accounted for in POTW effluents or sludge streams. The disappearance occurs because of volatilization and biodegradation. Adsorption of volatile organics accounts for no more than 10 percent of the VOCs in the influent.(9)

Acid Compounds

It is believed that most of the removal observed for the acid compound group is through biodegradation. Biodegradation averaged about 84 percent with equal partitioning of the remaining load between sludge (8 percent) and the final effluent (8 percent).(9) The influent and effluent concentrations for 2-chlorophenol at POTWs are identical, which is likely the result of the formation of this compound in the chlorination process, before discharge of the final effluent. This compound also may be a chemical or bacterial degradation product of other chlorinated compounds.(10) The removal of 2,4-dichlorophenol in POTWs also is reported as low, and at low influent concentrations, the expected effluent concentration is actually larger. This is also a likely result of the chlorination process. The reduction factors for tri- and pentachlorophenol are higher than observed for mono- and dichlorophenol because these compounds are not likely to be formed during chlorination of the final effluent.(10) The methylated phenols generally experience greater percent removals than the chlorinated phenols, possibly due to their greater biodegradability during aerobic treatment. Nitrophenols show the least reduction of any of the phenols during biological treatment due to their relatively low degradability through the sewage treatment plant. The low apparent sludge accumulation may be due to their low adsorption capacity onto bacterial solids, which probably corresponds with the strong electronegative character of the nitrogroup resulting from the inductive and resonance electron withdrawal from the aromatic ring.(10)

Base/Neutral Compounds

Removal mechanisms for this group are the least uniform of all pollutant groups. Most of the POTW influent loadings for this group are contributed by the phthalates,(9) with certain phthalates [bis(2-ethylhexyl) phthalate, di-n-octyl phthalate] partitioning to the sludge while others (dimethyl phthalate, diethyl phthalate) generally are removed via biodegradation. Other more frequently detected base/neutral compounds, such as the chlorobenzenes, range from low to moderate biodegradation and moderate to high sludge partitioning. Volatilization for all chlorobenzenes generally falls in the moderate range.

Pesticides and PCBs

Compounds in this group generally experience fairly high removals in activated sludge systems with the principal removal mechanisms being biodegradation and sludge partitioning. Substantial sludge accumulations were noted for pesticides and herbicides in anaerobically digested sludge.(10)

Metals

The decrease in the wastewater concentrations of all heavy metals corresponded to increases in the sludge levels.(10)

4.2 ANALYSIS OF POLLUTANT FATE WITHIN POTW COLLECTION SYSTEMS

4.2.1 Analysis of Pollutant Volatilization Within POTW Collection Systems

Little is known about DSS pollutant fate and behavior in POTW collection systems. Most of the research and sampling study work performed previously focused on pollutant concentrations either at the discharge point of specific industrial contributors or at the POTW. However, there have been numerous case studies involving sewer maintenance workers who have been injured or killed from hazardous gases formed in sewers (see Appendix K). While most accidents have been caused by the formation of hydrogen sulfide gases, more recent incidents have been linked to certain organic pollutants that either volatilized or reacted with hydrogen sulfide within the POTW collection system.

Study of pollutant behavior in sewers is complicated by many diverse influences, including wastewater characteristics, flow volume, flow velocity, variations in flow level, materials of construction, and rainfall events. Moreover, collection systems are difficult and dangerous systems from which to sample with any degree of accuracy. Therefore, because of the above-mentioned limitations and hindrances to potential research, a quantitative estimate of the amount of organic pollutants volatilized in POTW collection systems cannot be made at this time. However, a recent sampling study in a large POTW collection system revealed significant levels of many pollutants in the space above wastewater surfaces in the interceptor sewer.(15) Also, on a qualitative basis, recent EPA-WERL calculations using a shallow stream desorption model indicate that volatile organics tend to desorb rapidly into the gas phase in the sewers. This indicates that in combined storm and sanitary sewers, transfer into the air of organics would occur at catch basins and manholes, while transfer would be virtually nonexistent in separate sanitary sewers with limited air exchange.

Although there is limited information on the quantitative fate of DSS pollutants in POTW collection systems, a large body of information exists on the relative volatility of various DSS pollutants in sewer systems related to fire risk and explosion hazards. Table 4-1 presents a compilation of various pollutant characteristics related to fire and explosion hazards for those DSS pollutants with flashpoints that fall within the range of ambient temperatures found in POTW collection systems. A rating of each pollutant's relative health, flammability and reactivity risks also is included.

4.2.2 Analysis of Potential for Ground-Water Contamination

Although little is known about the fate of DSS pollutants in POTW collection systems, even less is known about potential ground-water contamination due to the migration of these pollutants from POTW collection systems. In the past, Federal, State, and local regulatory authorities have focused their attention on infiltration/inflow (I/I) problems associated with POTW collection systems rather than potential incidents of outflow from sewers. Therefore, little is known about the overall quantity of wastewater flow escaping from POTW collection systems. However, based on the characteristics

TABLE 4-1. SUMMARY OF FIRE/EXPLOSION RISK CHARACTERISTICS FOR THOSE RCRA STUDY POLLUTANTS WHOSE FLASHPOINT IS BELOW AN AMBIENT TEMPERATURE (100°F) THAT MIGHT BE FOUND IN POTW COLLECTION SYSTEMS

Pollutant	Flash Point °F	Ignition Temp °F	Flammable Limits (% by Vol.) Lower	Upper	Boiling Point °F	Hazard Identification Health	Flammability	Reactivity
TIER ONE								
Acetone	-4.0	869	2.5	13	133	1	3	0
N-Butyl Alcohol	98	650	1.4	11.2	243	1	3	0
Carbon Disulfide	-22.0	194	1.3	50	115	2	3	0
Chlorobenzene	82.0	1099	1.3	9.6	270	2	3	0
Ethyl Acetate	24.0	800	2.0	11.5	171	1	3	0
Ethyl Benzene	59	--	1.0	6.7	277	--	--	--
Ethyl Ether	-49	356	1.9	36.0	95	2	4	1
Methanol	52	867	6.0	36.0	147	1	3	0
Methyl Ethyl Ketone	16	759	1.4	11.4	176	1	3	0
Methyl Isobutyl Ketone	64	840	1.2	8.0	244	2	3	0
Pyridine	68	900	1.8	12.4	239	2	3	0
Toluene	40	896	1.2	7.1	231	2	3	0
Xylenes	81-90	867-984	1.0-1.1	7.0	281-292	2	3	0
TIER TWO								
Acetaldehyde	-38	347	4.0	60	70	2	4	2
Acetonitrile	42	975	3.0	16.0	179	2	3	0
Acetyl Chloride	40	734	1.1	2.7	124	3	3	2
Acrolein	-15	428	2.8	31	125	3	3	2
Benzene	12	928	1.3	7.9	176	2	3	0
Chloromethane	-50	1170	8.1	17.4	-11	2	4	0
Cumene	96	795	0.9	6.5	306	2	3	0

TABLE 4-1. SUMMARY OF FIRE/EXPLOSION RISK CHARACTERISTICS FOR THOSE RCRA STUDY POLLUTANTS WHOSE FLASHPOINT IS BELOW AN AMBIENT TEMPERATURE (100°F) THAT MIGHT BE FOUND IN POTW COLLECTION SYSTEMS (Continued)

Pollutant	Flash Point °F	Ignition Temp °F	Flammable Limits (% by Vol.) Lower	Flammable Limits (% by Vol.) Upper	Boiling Point °F	Hazard Identification Health	Hazard Identification Flammability	Hazard Identification Reactivity
Cyclohexane	-4	473	1.3	8.0	179	1	3	0
1,1-Dichloroethane	22	--	5.6	--	135-138	2	3	0
1,2-Dichloroethane	56	775	6.2	16	183	2	3	0
1,2-Dichloroethylene	-19	1058	6.5	15.5	89	2	4	2
1,2-Trans-Dichloroethylene	36	860	5.6	12.8	119	2	3	2
1,2-Dichloropropane	60	1035	3.4	14.5	205	2	3	0
Dimethylamine	Gas	752	2.8	14.4	45	3	4	0
p-Dioxane	54	356	2.0	22	214	2	3	1
Epichlorohydrin	88	772	3.8	21.0	239	3	2	2
Ethylene Oxide	-20	1058	3.0	100	51	2	4	3
Furan	32	--	2.3	14.3	88	1	4	1
Hydrazine	100	--	2.9	98	236	3	3	2
2-Nitropropane	75	802	2.6	11.0	248	2	3	1
Tetrahydrofuran	6	610	2	11.8	151	2	3	1
Vinyl Chloride	Gas	882	3.6	33.0	7	2	4	1
TIER 2A								
Acrylonitrile	32	898	3.0	17	171	4	3	2
Methyl Mercaptan	--	--	3.9	21.8	42.4	2	4	0
Styrene	88	914	1.1	7.0	295	2	3	2

Source: "Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids 1984," National Fire Protection Association, 1984.

TABLE 4-1. KEY TO CODES FOR HAZARD IDENTIFICATION INFORMATION (Continued)

Reactivity (Stability).

The assignment of degrees in the reactivity category is based upon the susceptibility of materials to release energy either by themselves or in combination with water. Fire exposure was one of the factors considered along with conditions of shock and pressure.

4 Materials which (in themselves) are readily capable of detonation or of explosive decomposition or explosive reaction of normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated.

3 Materials which (in themselves) are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement. Fire fighting should be done from an explosion-resistant location.

2 Materials which (in themselves) are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water. In advanced or massive fires, fire fighting should be done from a safe distance or from a protected location.

1 Materials which (in themselves) are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently. Caution must be used in approaching the fire and applying water.

0 Materials which (in themselves) are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

Flammability.

Susceptibility to burning is the basis for assigning degrees within this category. The method of attacking the fire is influenced by this susceptibility factor. For further information on this subject, refer to the column on "Extinguishing Method" and to its explanation on pages 5 and 6.

4 Very flammable gases or very volatile flammable liquids. Shut off flow, and keep cooling water streams on exposed tanks or containers.

3 Materials which can be ignited under almost all normal temperature conditions. Water may be ineffective because of the low flash point.

2 Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

1 Materials that must be preheated before ignition can occur. Water may cause frothing if it gets below the surface of the liquid and turns to steam. However, water fog gently applied to the surface will cause a frothing which will extinguish the fire.

0 Materials that will not burn.

Health.

In general, health hazard in fire fighting is that of a single exposure which may vary from a few seconds up to an hour. The physical exertion demanded in fire fighting or other emergency conditions may be expected to intensify the effects of any exposure. Only hazards arising out of an inherent property of the material are considered. The following explanation is based upon protective equipment normally used by fire fighters.

4 Materials too dangerous to health to expose fire fighters. A few whiffs of the vapor could cause death or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing. The normal full protective clothing and breathing apparatus available to the average fire department will not provide adequate protection against inhalation or skin contact with these materials.

3 Materials extremely hazardous to health but areas may be entered with extreme care. Full projective clothing, including self-contained breathing apparatus, coat, pants, gloves, boots, and hands around legs, arms and waist should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with full-faced mask self-contained breathing apparatus which provides eye protection.

1 Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

0 Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.

of the types of sewer systems in use and the various areas where POTW collections have been installed, some general conclusions regarding potential ground-water contamination can be drawn:

- Gravity flow collection systems would tend to have infiltration rather than exfiltration.
- Pressure sewers and nonpressure collection systems with a number of pump stations may be more susceptible to exfiltration.
- POTW collection systems installed in areas with relatively high water tables generally will have more infiltration than exfiltration.
- POTW collection systems installed in areas with low water tables may be more susceptible to exfiltration during dry weather conditions.

4.3 ANALYSIS OF POLLUTANT FATE WITHIN POTW TREATMENT SYSTEMS

4.3.1 Evaluation of POTW Removal Efficiencies - Pass Through to Receiving Waters

Appendix O presents the estimated acclimated and unacclimated removal efficiences for all DSS pollutants. Since most of the unacclimated removal efficiencies generated were ranges, the midpoint and the low-end of the range were chosen to represent unacclimated removal efficiencies (the few acclimated ranges were presented as midpoints). The majority of these estimated removal efficiencies were obtained from EPA-WERL, which generated them from priority pollutant data obtained from three EPA-WERL research projects.(6,11,12,13) EPA-WERL personnel also used their BPJ to extrapolate removal efficiencies on priority pollutants for estimating removals for all DSS pollutants. All estimated acclimated removal efficiencies generated by EPA-WERL were based on the assumption that each pollutant enters the POTW at 500 ppb. The analysis assumes a conventional activated sludge treatment system meeting secondary treatment requirements. In addition, it was assumed that the pollutant being evaluated was discharged to the POTW with a group of typical toxic pollutants at low background level concentrations. Experimental data not based on these assumptions were adjusted accordingly in EPA-WERL's BPJ estimates. Unacclimated percent removal estimates were obtained using experimental data from one of the above-mentioned ongoing research studies(11) and from EPA-WERL's knowledge of the available literature and its ongoing treatability studies. A limited amount of removal data on unacclimated operation supported the development of the estimates both on overall removal and on volatilization fractions.

Although these acclimated and unacclimated removal efficiencies are considered accurate estimates using the study data provided, there is one limitation in its use. The steady pollutant feed rates that were used in all the acclimated experiments contrast with the slug loadings and batch discharges which POTWs experience in everyday operation. Also, the efficient operation of batch- and pilot-scale systems cannot be duplicated at the majority of full-scale POTWs. However, full-scale POTWs would only experience a limited number of pollutant loadings, which might cause removal efficiencies to drop to the low end of the unacclimated removal efficiency range.

In an attempt to determine which estimate approximates actual full-scale POTW removal efficiencies, a comparison was made between removals obtained from the 40 POTW Study data base and corresponding DSS pollutant removal estimates. Table 4-2 presents the acclimated and unacclimated percent removal estimates made by EPA-WERL and the percent removals obtained using the 40 POTW Study data for selected DSS pollutants. Although there are certain agreements, EPA-WERL estimates of percent removal are not overwhelmingly in agreement with the actual percent removal data from the 40 POTW Study. Therefore, all three removal efficiencies will be presented to give a complete basis for comparison of the data.

4.3.2 Analysis of Pollutant Volatilization Rates Within POTW Treatment Systems

Appendix P presents the volatilization rates selected from the various data sources for acclimated and unacclimated activated sludge treatment systems. The majority of these volatilization rates were taken directly from EPA-WERL's estimates with a few adjustments to certain pollutants, including those made to assure completely unacclimated volatilization rates.[1] Table 4-3

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[1] EPA-WERL assumed a background concentration of benzene and toluene in domestic sewage that they assumed lowered volatilization and raised biodegradation in unacclimated systems. To assure completely unacclimated volatilization rates, the rates for these two compounds were adjusted higher based on the unacclimated volatilization rates of two chemically similar, but less prevalent compounds, xylene and ethylbenzene.

TABLE 4-2. COMPARISON OF ESTIMATED PERCENT REMOVALS WITH THOSE OBTAINED USING THE 40 POTW STUDY DATA BASE

	Percent Removals			
		Unacclimated		
Pollutant	Acclimated	Median	Low	40 POTW
Arsenic	50	-	-	* (93.9)
Cadmium	27	-	-	86.6
Chlorobenzene	90	90	90	* (99.5)
Chromium	70	-	-	78.9
1,2-Dichlorobenzene	90	87	85	91.6
Dichlorodifluoromethane	95	95	95	* (80.3)
Ethylbenzene	95	90	90	96.0
Lead	90	-	-	88.5
Mercury	50	-	-	82.0
Methylene chloride	95	87	85	**
Nitrobenzene	90	25	20	-
Selenium	50	-	-	-
Silver	90	-	-	91.3
Tetrachloroethylene	90	85	80	80.1
Toluene	95	90	90	97.6
1,1,1-Trichloroethane	95	90	85	87.6
Trichloroethylene	95	87	85	92.0
Trichlorofluoromethane	95	90	85	* (97.9)
Acrolein	95	95	95	-
Antimony	-	-	-	* (71.5)
Benzene	95	90	90	94.1
Bis(2-chloroethyl) ether	90	50	30	-
Bis(2-chloroethoxy) methane	10	10	10	-
Bis(2-ethylhexyl) phthalate	90	90	90	73.5
Bromomethane	95	95	95	* (100)
Butyl benzyl phthalate	95	90	90	98.7
Para-chloro-meta-cresol	95	50	40	* (96.7)
Chloroethane	95	90	90	-
Chloroform	90	80	80	67.6
Chloromethane	95	90	90	97.4
2-chloronaphthalene	95	80	80	-
Cyanide	90	-	-	**
Di-n-butyl phthalate	90	90	90	88.2
1,3-Dichlorobenzene	90	87	85	* (100)
1,4-Dichlorobenzene	90	87	85	* (94.9)
1,1-Dichloroethane	90	80	80	* (100)
1,2-Dichloroethane	90	50	30	* (55.4)
1,1-Dichloroethylene	95	90	90	* (81.1)
1,2-Trans-dichloroethylene	90	80	80	92.8
2,4-Dichlorophenol	95	55	50	-
1,2-Dichloropropane	90	70	70	* (100)
Diethyl phthalate	90	75	70	* (99.2)
2,4-Dimethylphenol	95	85	80	-

TABLE 4-2. COMPARISON OF ESTIMATED PERCENT REMOVALS WITH THOSE OBTAINED USING THE 40 POTW STUDY DATA BASE (Continued)

Pollutant	Percent Removals			
	Acclimated	Unacclimated Median	Unacclimated Low	40 POTW
Dimethyl phthalate	95	65	60	* (100)
Di-N-octyl phthalate	90	90	90	* (100)
Hexachloro-1,3-butadiene	95	90	90	-
Hexachloroethane	95	90	90	-
Naphthalene	95	75	70	98.1
Nickel	35	-	-	47.5
N-Nitrosodimethyl amine	90	75	70	-
Pentachlorophenol	95	25	20	60.6
Phenol	95	85	80	96.7
1,1,2,2-Tetrachloroethane	90	25	20	* (93.8)
Tribromomethane	65	35	30	* (90.5)
1,2,4-Trichlorobenzene	85	85	85	* (96.6)
1,1,2-Trichloroethane	80	25	20	* (98.6)
2,4,6-Trichlorophenol	95	55	50	-
Vinyl chloride	95	95	95	99.8
Acenaphthylene	95	90	90	-
Acrylonitrile	-	75	70	-
Anthracene	95	90	90	* (83.1)
2-Chlorophenol	95	65	60	-
2,4-Dinitrophenol	90	75	70	-
Aldrin	90	90	90	* (91.2)
Chlordane	90	90	90	-
Endrin	95	90	90	-
Toxaphene	95	90	90	-

NOTE: *Fewer than five of the POTWs had a percent removal for this pollutant. Percent removal based on fewer than five POTWs is indicated in parentheses.

**Percent removals were deleted due to analytical difficulties.

TABLE 4-3. ADJUSTMENTS TO EPA-WERL'S ESTIMATED VOLATILIZATION RATES

POLLUTANT	OLD VOLATILIZATION RATES ACCLIMATED	OLD VOLATILIZATION RATES UNACCLIMATED	NEW VOLATILIZATION RATES ACCLIMATED	NEW VOLATILIZATION RATES UNACCLIMATED	REASON
CUMENE	40	90	40	60	LOWERED UNACCLIMATED RATE BASED ON A HIGH KOW WHICH WOULD CAUSE IT TO PARTITION TO THE SLUDGE RATHER THAN VOLATILIZE.
METHANETHIOL	0	0	40	60	RAISED BOTH RATES BASED ON HENRY'S LAW CONSTANT, KOW VALUE AND THE COMPOUND'S SOLUBILITY. VALUES WERE CHOSEN BASED ON THE COMPOUND'S SIMILARITY TO METHYLENE CHLORIDE.
1,1,2,2 - TETRACHLOROETHANE	40	90	40	60	LOWERED UNACLIMATED RATE BASED ON COMPOUND'S HIGH KOW, LOW HENRY'S CONSTANT AND LOW BIODEGRADABILITY.
1,1,1,2 - TETRACHLOROETHANE	80	90	50	60	LOWERED BOTH RATES BASED ON RELATIVELY HIGHER HENRY'S CONSTANT THAN 1,1,2,2-TETRACHLOROETHANE.
DICHLOROPROPANOL	10	80	10	50	LOWERED UNACCLIMATED RATE BASED ON LOW HENRY'S CONSTANT AND KOW AND RAPID BIODEGRADABILITY.
TETRAHYDROFURAN	10	10	30	70	RAISED BOTH RATES BASED ON ITS SIMILARITY TO FURAN. HOWEVER, SINCE THIS COMPOUND'S HENRY'S CONSTANT IS AN ORDER OF MAGNITUDE LOWER, IT'S RATES WERE ADJUSTED LOWER THAN FURAN.
TETRACHLOROBENZENE	10	10	30	30	RAISED BOTH RATES BASED ON ITS SIMILARITY TO 1,2,4 - TRICHLOROBENZENE. HOWEVER, SINCE THIS COMPOUND'S HENRY'S CONSTANT IS AN ORDER OF MAGNITUDE LOWER IT'S RATES WERE ADJESTED LOWER THAN 1,2,3 - TRICHLOROBENZENE.

TABLE 4-3. ADJUSTMENTS TO EPA-WERL'S ESTIMATED VOLATILIZATION RATES (Continued)

POLLUTANT	OLD VOLATILIZATION RATES ACCLIMATED	OLD VOLATILIZATION RATES UNACCLIMATED	NEW VOLATILIZATION RATES ACCLIMATED	NEW VOLATILIZATION RATES UNACCLIMATED	REASON
BENZENE	25	50	25	80	RAISED UNACCLIMATED RATE TO REPRESENTATIVE RATE FOR OTHER CHEMICALLY SIMILAR COMPOUNDS TO ASSURE TRULY UNACCLIMATED CONDITIONS. (SEE FOOTNOTE IN TEXT)
TOLUENE	25	40	25	80	RAISED UNACCLIMATED RATE TO REPRESENTATIVE RATE TO REPRESENTATIVE RATE FOR OTHER CHEMICALLY SIMILAR COMPOUNDS TO ASSURE TRULY UNACCLIMATED CONDITIONS. (SEE FOOTNOTE IN TEXT)

NOTE: FOR COMPOUNDS MISSING EIHTER ACCLIMATED OR UNACCLIMATED VOLATILIZATION RATES, THE EXISTING VALUE WAS SUBSTITUTED FOR THE MISSING ONE.

presents the pollutants whose volatilization rates were adjusted and the reasoning behind each adjustment.

In general, EPA-WERL's volatilization rate estimates were guided by data from three EPA-WERL research projects.(6,11,12,13) Experimental data for a limited set of pollutants were extracted from these studies and were extrapolated to the remainder of the DSS pollutants based on a combination of physical/chemical properties (Henry's Law Constant and Octanol/Water Partition Coefficients) and BPJ. These estimates account for volatilization in both the primary and secondary treatment systems, but do not account for volatilization in such preliminary treatment components as grit chambers and equalization basins and therefore may underestimate overall treatment system volatilization. Using other evaluation criteria, such as boiling point and solubility as well as review of the existing literature, many of EPA-WERL's estimated volatilization rates were confirmed. However, all the studies mentioned above have utilized closed reactors, which may not simulate actual open-tank activated sludge conditions. Using certain open-tank experimental volatilization results from the same ongoing EPA-WERL project(11) and adjusting the aeration rate to a value more typical for a full-scale activated sludge system yielded volatilization rates significantly higher than those derived by EPA-WERL.

In addition, a number of pollutants that were considered volatile for the purposes of selection for this study were assigned acclimated and unacclimated volatilization rates of zero by EPA-WERL. Since EPA-WERL's estimates were BPJ for most of the DSS pollutants, and since these compounds would in most cases be considered volatile pollutants, a baseline volatilization rate of 5 percent was assigned to these pollutants.

4.3.3 Analysis of Sludge Removal Rates Within POTW Treatment Systems

The estimated sludge partition rates for each of the DSS pollutants are presented in Appendix Q. The general methodology used to derive these rates was as follows:

- Calculate mass balances for each priority pollutant for each POTW in the 40 POTW Study data base

- Calculate the fraction of the mass removed which was partitioned to the sludge for each priority pollutant for each POTW
- Average the fraction partitioned for each priority pollutant across all POTWs
- Group the average partition rates by the eight Henry's Law Constant/ Partition Coefficient groupings shown in Table 4-4
- Calculate an average partition rate for each of the eight Henry's Law Constant/Partition Coefficient groupings and extrapolate these group averages to the DSS pollutants in each group with no individual sludge partition rate.

Data were not available to determine acclimated and unacclimated sludge partition factors.

Certain editing rules were utilized to calculate the fraction of the mass of pollutant removed that was partitioned to the sludge because of the relatively low influent concentrations of certain pollutants found in the 40 POTW Study data base. In reviewing the mass balance calculations and comparing them to the average concentration values, it was determined that the mass balances being calculated for certain pollutants were based on extremely low pollutant concentrations that were not considered accurate for the purposes of illustrating removals. Therefore, an editing rule was established that allowed only those mass balance calculations with an influent mass of at least 2.0 lbs/day to be used to derive the fraction partitioned for each pollutant at each POTW.

The eight Henry's Law Constant/Partition Coefficient groups and the ranges for the constants associated with each group were developed by EPA-WERL as a useful way to make their BPJ estimates for overall percentage removal and volatilization rates while still taking into account the general physical/ chemical properties of the pollutants. For the same reasons, these same groupings were utilized to project the individual sludge partition rates obtained from the 40 POTW Study data base to the remainder of the DSS pollutants. An incidental check of these individual sludge partition rates was performed as part of the evaluation of biodegradation rates with the results discussed in the following section.

TABLE 4-4. HENRY'S LAW CONSTANT/PARTITION COEFFICIENT GROUPINGS USED TO EXTRAPOLATE AVERAGE PARTITION RATES

Grouping	Range of Values	Average Partition Coefficient for Grouping
LOW Kow/LOW HC	Kow($<10^2$);HC($<10^{-3}$ atm-m^3/Mole)	0.10
LOW Kow/MODERATE HC	Kow($<10^2$);HC($\geq 10^{-3}$-$<10^{-2}$ atm-m^3/Mole)	0.1395
LOW Kow/HIGH HC	Kow($<10^2$);HC($>10^{-2}$ atm-m^3/Mole)	0.0075
MODERATE Kow/LOW HC	Kow($>10^2$-10^4);HC($<10^{-3}$ atm-m^3/Mole)	0.079
MODERATE Kow/MODERATE HC	Kow($>10^2$-10^4);HC($\geq 10^{-3}$-$<10^{-2}$ atm-m^3/Mole)	0.149
MODERATE Kow/HIGH HC	Kow($>10^2$-10^4);HC($>10^{-2}$ atm-m^3/Mole)	0.035
HIGH Kow/LOW HC	Kow($>10^4$);HC($<10^{-3}$ atm-m^3/Mole)	0.366
HIGH Kow/MODERATE HC	Kow($>10^4$);HC($\geq 10^{-3}$-$<10^{-2}$ atm-m^3/Mole)	0.0895

4.3.4 Evaluation of POTW Biodegradation Processes

Table 4-5 presents the estimated acclimated and unacclimated rates of biodegradation for the DSS pollutants for which individual sludge partition rates could be calculated. The general methodology used to derive these biodegradation rates was to assume that all removal of a pollutant occurs via three possible removal mechanisms: (1) volatilization; (2) partition to the sludge; and (3) biodegradation. Using this assumption, the estimated fraction biodegraded would be equal to the removal remaining after the estimated fraction volatilized and the estimated fraction partitioned to the sludge have been subtracted from 100 percent (or 1.00). The estimated acclimated and unacclimated biodegradation rates listed in Table 4-5 have been calculated in this manner using the estimated acclimated and unacclimated volatilization rates and the single partition rate listed for each pollutant.

The comparison of the estimated acclimated biodegradation rate to the qualitative BPJ estimate of each pollutant's biodegradability in Table 4-5 (which was obtained from EPA-WERL) allows not only a relative check of the calculated biodegradation rates, but also a method to evaluate the estimates of the fraction partitioned to the sludge. In performing this total evaluation, a total removal balance error of +25 percent (or 0.25) was considered acceptable when the relative inaccuracy of the analytical and sampling methods for sludge samples is taken into account. Based on this evaluation procedure, the following DSS pollutants remain inconsistent with biodegradation estimates:

> 1,1,2,2-Tetrachloroethane - Biodegradation is listed qualitatively as slow, but the estimated biodegradation rate for acclimated systems is 56 percent. Original volatilization rate of 90 percent may be more appropriate for this pollutant than current 40 percent/60 percent.
>
> 1,1,2-Trichloroethane - Biodegradation is listed qualitatively as slow, but the estimated biodegradation rate for acclimated systems is 50 percent. No competing removal mechanism, so qualitative estimate may have to be revised.
>
> Di-N-Octyl Phthalate - Biodegradation is listed qualitatively as moderate, but the estimated biodegradation rate for acclimated systems is 92 percent. Dominant removal mechanism should be partitioning based on very high Kow, but 40 POTW Study data show only 8 percent. Sludge partition rate probably should be revised.

TABLE 4-5. SUMMARY TABLE OF ESTIMATED FRACTION REMOVED: STRIPPED, PARTITIONED AND BIODEGRADED FOR THOSE POLLUTANTS WITH INDIVIDUAL FRACTION PARTITIONED FIGURES

Pollutant	Acclimated[1] Fraction Removed	Unacclimated[1] Fraction Removed		Acclimated[1] Fraction Stripped	Unacclimated[1] Fraction Stripped	Fraction Partitioned[2] To Sludge	Acclimated[3] Fraction Biodegrade	Unacclimated[3] Fraction Biodegrade	Relative Acclimated[1] Biodegradability
		Median	Low						
1,2-Dichloroethane	0.90	0.50	0.30	0.50	0.90	0.05	0.45	0.05	Moderate
Phenol	0.95	0.85	0.80	0	0	0.15	0.85	0.85	Rapid
Naphthalene	0.95	0.75	0.70	0.30	0.30	0.28	0.42	0.42	Moderate
1,1,2,2-Tetrachloroethane	0.90	0.25	0.20	0.40	0.60	0.04	0.56	0.36	Slow
1,1,2-Trichloroethane	0.80	0.25	0.20	0.50	0.80	0.	0.50	0.20	Slow
Diethyl Phthalate	0.90	0.75	0.70	0	0	0.01	0.99	0.99	Rapid
Dimethyl Phthalate	0.95	0.65	0.60	0	0	0	1.00	1.00	Rapid
Pentachlorophenol	0.95	0.25	0.20	0	0	0.18	0.82	0.82	Moderate
Bis(2-Ethylhexyl) Phthalate	0.90	0.90	0.90	0	0	0.73	0.27	0.27	Moderate
Butyl Benzyl Phthalate	0.95	0.90	0.90	0	0	0.45	0.55	0.55	Rapid
Di-n-Butyl Phthalate	0.90	0.90	0.90	0	0	0.22	0.78	0.78	Rapid
Di-n-Octyl Phthalate	0.90	0.90	0.90	0	0	0.08	0.92	0.92	Moderate
Anthracene	0.95	0.90	0.90	0	0	0.55	0.45	0.45	Moderate
1,1-Dichloroethane	0.90	0.80	0.80	0.70	0.90	0	0.30	0.10	Moderate
Chloroform	0.90	0.80	0.80	0.70	0.90	0.02	0.28	0.08	Moderate
Trans-1,2-Dichloro-Ethylene	0.90	0.80	0.80	0.70	0.90	0.54	0	0	Moderate
1,2-Dichloropropane	0.90	0.70	0.70	0.50	0.90	0	0.50	0.10	Slow
Chlorobenzene	0.90	0.90	0.90	0.30	0.50	0.15	0.55	0.35	Moderate
1,2-Dichlorobenzene	0.90	0.87	0.85	0.50	0.90	0.35	0.15	0	Slow
1,3-Dichlorobenzene	0.90	0.87	0.85	0.50	0.90	0.03	0.47	0.07	Slow
1,4-Dichlorobenzene	0.90	0.87	0.85	0.50	0.90	0.25	0.25	0	Slow
Ethylbenzene	0.95	0.90	0.90	0.25	0.80	0.06	0.69	0.14	Rapid
Toluene	0.95	0.90	0.90	0.25	0.80	0.28	0.47	0	Rapid
Trichloroethylene	0.95	0.87	0.85	0.70	0.80	0.06	0.24	0.14	Moderate
Benzene	0.95	0.90	0.90	0.25	0.80	0.02	0.74	0.18	Moderate
1,2,4-Trichlorobenzene	0.85	0.85	0.85	0.50	0.60	0.09	0.41	0.31	Slow
Vinyl Chloride	0.95	0.95	0.95	0.90	0.95	0.02	0.08	0.03	Moderate
Bromoethane	0.95	0.95	0.95	0.90	0.95	0	0.10	0.05	Moderate
Carbon Tetrachloride	0.90	0.85	0.80	0.80	0.90	0.13	0.07	0	Moderate
Dichlorodifluoromethane	0.95	0.95	0.95	0.95	0.95	0	0.05	0.05	Moderate
Tetrachloroethylene	0.90	0.85	0.80	0.50	0.80	0.03	0.47	0.17	Moderate
1,1,1-Trichloroethane	0.95	0.90	0.85	0.80	0.90	0.01	0.19	0.09	Rapid
1,1-Dichloroethylene	0.95	0.90	0.90	0.80	0.90	0	0.10	0.10	Moderate
Trichlorofluoromethane	0.95	0.90	0.85	0.80	0.90	0	0.20	0.10	Moderate

Note: 1. From 9/26/85 Memo from D.F. Bishop to T.P. O'Farrell "Estimation of Removability and Impact of RCRA Toxics"

2. Calculated using the Final Report "Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume I"

3. Calculated by difference.

1,2-Trans-Dichloroethylene - Biodegradation is listed qualitatively as moderate, but the estimated biodegradation rate for acclimated systems is 0 percent based on a sludge partition rate of 54 percent which is much too high given a Kow = 34. Sludge partition rate probably should be revised.

Since the remaining DSS pollutants will have biodegradation rates that have been calculated using the estimated sludge partition rates that were extrapolated with the eight Henry's Law Constant/Partition Coefficient groups, it would be expected that more inconsistencies between calculated biodegradation rates and the qualitative biodegradation estimates will exist for these DSS pollutants than for those DSS pollutants with actual sludge partition rates. However, time would not allow a pollutant-by-pollutant assessment of these extrapolated rates.

4.3.5 Evaluation of Pollutant Interference with POTW Treatment Systems

Available information for interference as a result of DSS pollutants can be classified into two groups. The first group contains a qualitative assessment of POTW plant upsets supplemented by specific citations of case studies where DSS pollutants had inhibited conventional activated sludge units. The AMSA survey cited in this study presents these case studies of POTW upsets and inhibitions. The survey reveals that DSS pollutants, such as pesticides and many organic solvents, have significant detrimental effects on the operation of conventional activated sludge processes.

The second group of sources present data on POTW upset and inhibition levels that are experimental but quantitative in nature. A review of the available literature was conducted of EPA documents, engineering journals, and scientific experiments, and expert consensus BPJ estimates were gathered to summarize the available knowledge of certain DSS pollutants within typical (conventional activated sludge) POTW treatment processes. Table 4-6 summarizes a recent literature review effort for certain DSS organics, inorganics, and metals. An estimation of the threshold inhibitory effect concentration for each compound for activated sludge, anaerobic digestion, and nitrification unit processes also is presented. In general, inhibitory analysis done under steady-state conditions can be affected greatly by slow specific growth rates

TABLE 4-6. REPORTED VALUES FOR BIOLOGICAL PROCESS TOLERANCE LIMITS OF ORGANIC PRIORITY POLLUTANTS

	Threshold of Inhibitory Effect					
	Activated Sludge		Anaerobic Digestion		Nitrification	
Pollutant	mg/l[a]	Reference	mg/l[a]	Reference	mg/l[a]	Reference
Acenaphthene	NI[b] at 10	1				
Acrolein	NI at 62	2				
Acrylonitrile	NI at 152	2	5	3		
Benzene	125	4				
Benzidine	5	5	5	3		
Carbon Tetrachloride	NI at 10	1	2.9	6		
Chlorobenzene	NI at 1	7	0.96[c]	8		
1,2,4-Trichlorobenzene	NI at 6	1				
Hexachlorobenzene	5	1				
1,2-Dichloroethane	NI at 258	2	1	3		
1,1,1-Trichloroethane	NI at 10	1				
Hexachloroethane	NI at 10	1				
1,1-Dichloroethane	NI at 10					
1,1,2-Trichloroethane	NI at 5	1				
1,1,2,2-Tetrachloroethane	NI at 201	2	20	9		
bis-(2-Chloroethyl) Ether	NI at 10	1				
2-Chloroethyl Vinyl Ether	NI at 10	1				
2-Chloronaphthalene	NI at 10	1				
2,4,6-Trichlorophenol	50	10				
para-Chloro-*meta*-cresol	NI at 10	1				
Chloroform	NI at 10	1	1	11	10	3
2-Chlorophenol	NI at 10	1				
1,2-Dichlorobenzene	5	1	0.23[c]	8		
1,3-Dichlorobenzene	5	1				
1,4-Dichlorobenzene	5	1	1.4[c]	8		
1,1-Dichloroethylene	NI at 10	1				
1,2-*trans*-Dichloroethylene	NI at 10	1				
2,4-Dichlorophenol	NI at 75	2				
1,2-Dichloropropane	NI at 182	2				
1,3-Dichloropropylene	NI at 10	1				
2,4-Dimethylphenol	NI at 10	1				
2,4-Dinitrotoluene	5	1				
2,6-Dinitrotoluene	5	1				
1,2-Diphenylhydrazine	5	1				
Ethylbenzene	NI at 10	1				
Fluoranthene	NI at 5	1				
bis-(2-Chloroisopropyl) Ether	NI at 10	1				
Methylene Chloride			100	3		
Chloromethane	NI at 180	2	3.3	6		
Bromoform	NI at 10	1				
Dichlorobromomethane	NI at 10	1				
Trichlorofluoromethane	NI at 10	1	0.7	3		
Chlorodibromomethane	NI at 10	1				
Hexachlorobutadiene	NI at 10	1				
Hexachlorocyclopentadiene	NI at 10	1				
Isophorone	NI at 15.4	12				
Naphthalene	500	13				
Nitrobenzene	500	13				
2-Nitrophenol	NI at 10	1				
4-Nitrophenol	NI at 10	1				
2,4-Dinitrophenol	1	1			150	3

TABLE 4-6. REPORTED VALUES FOR BIOLOGICAL PROCESS TOLERANCE LIMITS OF ORGANIC PRIORITY POLLUTANTS (Continued)

Table I. continued

Pollutant	Threshold of Inhibitory Effect: Activated Sludge mg/l[a]	Activated Sludge Reference	Anaerobic Digestion mg/l[a]	Anaerobic Digestion Reference	Nitrification mg/l[a]	Nitrification Reference
N-Nitrosodiphenylamine	NI at 10	1				
N-Nitroso-di-N-propylamine	NI at 10	1				
Pentachlorophenol	0.95	7	0.2	14		
Phenol	200	15.16			4	3
bis-(2-Ethyl Hexyl) Phthalate	NI at 10	1				
Butyl Benzyl Phthalate	NI at 10	1				
Di-*n*-butyl Phthalate	NI at 10	1				
Di-N-octyl Phthalate	NI at 16.3	12				
Diethyl Phthalate	NI at 10	1				
Dimethyl Phthalate	NI at 10	1				
Chrysene	NI at 5	1				
Acenaphthylene	NI at 10	1				
Anthracene	500	13				
Fluorene	NI at 10	1				
Phenanthrene	500	13				
Pyrene	NI at 5	1				
Tetrachloroethylene	NI at 10	1	20	3		
Toluene	NI at 35	12				
Trichloroethylene	NI at 10	1	20	3.9		
Aroclor-1242	NI at 1	17				
Aroclor-1254	NI at 1	17				
Aroclor-1221	NI at 1	17				
Aroclor-1232	NI at 10	1				
Aroclor-1016	NI at 1	17				

[a] Unless otherwise indicated.

[b] NI = no inhibition at tested concentrations. No concentration is listed if reference lacked concentration data.

[c] % wt/wt dry solids.

TABLE 4-6. REPORTED VALUES FOR BIOLOGICAL PROCESS TOLERANCE LIMITS OF ORGANIC PRIORITY POLLUTANTS (Continued)

	Threshold of Inhibitory Effect					
	Activated Sludge		Anaerobic Digestion		Nitrification	
Pollutant	mg/l^a	Reference	mg/l^a	Reference	mg/l^a	Reference
Arsenic	0.1	18.19			1.5	19
Cadmium	1.0	19.20	5.2	21	0.02	3,22
Chromium(VI)	1	3.19	0.25	23	5	3
Chromium(III)	10	18			50	3
Copper	1.0	3.19	0.48	10	0.5	24
Cyanide	0.1	3.19	0.34	3	4	3.19
Lead	0.1	3.19	0.5	3		
Mercury	0.1	14			1365	3
Nickel	1	3.19	0.25	3	10	19
Silver	5	15,16				
Zinc	0.03	3	0.03	3	1.5	25

SOURCE: 1984 Purdue Industrial Waste Conference, "Impact of Priority Pollutants on Publicly Owned Treatment Works Processes: A Literature Review", L.L. Russell, C.B. Cain and D.I. Jenkins for the activated sludge biomass along with substrate levels and the effectiveness of the POTW's equalization to provide the necessary dilution to prevent inhibition. Also, a biomass acclimated to a toxic substrate is still subject to inhibition by that substrate, and hence the POTW should be designed or modified to react to variations in flow rate and substrate concentration.

4.3.6 Estimating the Risk Posed by the Migration of Selected Contaminants from POTW Surface Impoundments to Drinking Water Wells

An attempt was made to estimate the potential risk posed by the migration of selected DSS pollutants from POTW surface impoundments to drinking water wells using EPA's Toxic Location Model. This model had been used previously to evaluate the risks posed to a population served by a drinking water well located 600 meters downgradient from a leaking impoundment. Although qualitative results were obtained for four DSS pollutants through the use of the Toxic Location Model, it was thought that more useful quantitative information on migration of pollutants from leaking POTW surface impoundments will be obtained from an ongoing EPA-OMPC study authorized under Section 3018(c) of the RCRA amendments. The results of this ongoing study will be incorporated into the final version of this report when and if they become available.

4.4 SUMMARY OF POLLUTANT FATE WITHIN POTW COLLECTION AND TREATMENT SYSTEM

Table 4-7 presents the estimated loadings of DSS pollutants that are being discharged to receiving waters based on acclimated and unacclimated treatment system peformance.

Table 4-8 presents the estimated air emissions for DSS pollutants based on acclimated and unacclimated treatment system performance. Table 4-8 includes estimated air emissions for those DSS Tier 1, 2, and 2A pollutants designated as volatile (which EPA-WERL assigned 0 percent volatilization factors), assuming a baseline volatilization rate of 0.5 percent for acclimated systems and 5 percent for unacclimated systems. It should be noted that unacclimated air emission loadings should be higher than those loadings calculated for acclimated systems. However, due to the decrease in overall removals going from acclimated to unacclimated systems, the total air emission loadings do not reflect this trend and the adjustment of the unacclimated

TABLE 4-7. LOADINGS TO SURFACE WATERS BASED ON POTW PASS THROUGH ANALYSIS

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated (%)	Unacclimated Range Median (%)	Unacclimated Range Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Acetone	8,317,227	3,780,558	5%	50%	70%	189,028	1,890,279	2,646,390
Arsenic	66,575	30,261	50%	50%	50%	15,131	15,131	15,131
Barium	0	0	10%	10%	10%	0	0	0
N-Butyl Alcohol	17,440	7,927	5%	10%	10%	396	793	793
Cadmium	189,856	86,298	73%	73%	73%	62,998	62,998	62,998
Carbon Disulfide	0	0	5%	15%	20%	0	0	0
Carbon Tetrachloride	225,086	102,312	10%	15%	20%	10,231	15,347	20,462
Chlorobenzene	687,835	312,652	10%	10%	10%	31,265	31,265	31,265
Chromium	4,660,026	2,118,194	30%	30%	30%	635,458	635,458	635,458
Cresols	0	0	5%	50%	60%	0	0	0
Cyclohexanone	1,282,984	583,175	15%	50%	70%	87,476	291,587	408,222
1,2-Dichlorobenzene	377,071	171,396	10%	13%	15%	17,140	22,281	25,709
Dichlorodifluoromethane	0	0	5%	5%	5%	0	0	0
Ethyl Acetate	188,860	85,845	5%	10%	10%	4,292	8,585	8,585
Ethyl Benzene	4,802,939	2,183,154	5%	10%	10%	109,158	218,315	218,315
Ethyl Ether	0	0	5%	50%	70%	0	0	0
Isobutanol	0	0	5%	10%	10%	0	0	0
Lead	3,449,009	1,567,731	30%	30%	30%	470,319	470,319	470,319
Mercury	42,439	19,290	50%	50%	50%	9,645	9,645	9,645
Methanol	31,717,755	14,417,161	0%	5%	5%	0	720,858	720,858
Methyl Ethyl Ketone	4,081	1,855	5%	50%	70%	93	928	1,299
Methyl Isobutyl Ketone	3,632,156	1,650,980	10%	50%	70%	165,098	825,490	1,155,686
Methylene Chloride	12,087,476	5,494,308	5%	13%	15%	274,715	714,260	824,146
Nitrobenzene	128,085	58,220	10%	75%	80%	5,882	43,665	46,576
Pyridine	50,021	22,737	85%	85%	90%	19,326	19,326	20,463
Selenium	142,577	64,808	50%	50%	50%	32,404	32,404	32,404
Silver	130,587	59,358	10%	10%	10%	5,936	5,936	5,936
Tetrachloroethylene	3,321,221	1,509,646	10%	15%	20%	150,965	226,447	301,929
Toluene	8,291,692	3,768,951	5%	10%	10%	188,448	376,895	376,895
1,1,1-Trichloroethane	8,652,375	3,932,898	5%	10%	15%	196,645	393,290	589,935
Trichloroethylene	3,803,526	1,728,875	5%	13%	15%	86,444	224,754	259,331
Trichlorofluoromethane	1,198	545	5%	10%	15%	27	54	82
1,1,2-TC 1,2,2-TF Ethane	0	0	10%	15%	20%	0	0	0
Xylenes	15,207,171	6,912,350	5%	13%	15%	345,618	898,606	1,036,853
Acetaldehyde	4,545	2,066	5%	5%	5%	103	103	103
Acetonecyanohydrin	0	0	10%	50%	70%	0	0	0
Acetophenone	0	0	20%	50%	70%	0	0	0
Acetyl Chloride	0	0	5%	50%	70%	0	0	0
Acrolein	1,648,576	749,353	5%	5%	5%	37,468	37,468	37,468
Aniline	5,811,272	2,641,487	5%	15%	20%	132,074	396,223	528,297
Antimony	221,685	100,766	40%	40%	40%	40,306	40,306	40,306
Benzene	4,099,249	1,863,295	5%	10%	10%	93,165	186,330	186,330
p-Benzoquinone	0	0	5%	50%	60%	0	0	0
Benzyl Chloride	230,338	104,699	10%	10%	10%	10,470	10,470	10,470

TABLE 4-7. LOADINGS TO SURFACE WATERS BASED ON POTW PASS THROUGH ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated (%)	·Unacclimated Range Median (%)	Unacclimated Range Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Bis-2-Chloroethoxy Methane	23	10	90%	90%	90%	9	9	9
Bis-2-Chloroethyl Ether	3,480	1,582	10%	50%	70%	158	791	1,107
Bis-2-Ethylhexyl Phthalate	2,660,146	1,209,157	10%	10%	10%	120,916	120,916	120,916
Bromomethane	813	370	5%	5%	5%	18	18	18
Butyl Benzyl Phthalate	1,613,930	733,605	5%	10%	10%	36,680	73,360	73,360
p-Chloro-m-Cresol	82,918	37,690	5%	50%	60%	1,885	18,845	22,614
Chloroethane	15,173	6,897	5%	10%	10%	345	690	690
Chloroform	4,189,128	1,904,149	10%	20%	20%	190,415	380,830	380,830
Chloromethane	27,230	12,377	5%	10%	10%	619	1,238	1,238
2-Chloronaphthalene	1,481	673	5%	20%	20%	34	135	135
Cumene	174,573	79,351	5%	5%	5%	3,968	3,968	3,968
Cyanide	3,165,294	1,438,770	40%	40%	40%	575,508	575,508	575,508
Cyclohexane	0	0	5%	5%	5%	0	0	0
Di-N-Butyl Phthalate	85,332	38,787	10%	10%	10%	3,879	3,879	3,879
1,3-Dichlorobenzene	7,471	3,396	10%	13%	15%	340	441	509
1,4-Dichlorobenzene	583,874	265,397	10%	13%	15%	26,540	34,502	39,810
1,1-Dichloroethane	29,666	13,485	10%	20%	20%	1,348	2,697	2,697
1,2-Dichloroethane	302,706	137,594	10%	50%	70%	13,759	68,797	96,316
1,1-Dichloroethylene	33,224	15,102	5%	10%	10%	755	1,510	1,510
Trans-1,2-Dichloroethylene	4,456	2,025	10%	20%	20%	203	405	405
2,4-Dichlorophenol	17,453	7,933	5%	45%	50%	397	3,570	3,967
1,2-Dichloropropane	209,097	95,044	10%	30%	30%	9,504	28,513	28,513
Dichloropropanol	0	0	10%	50%	70%	0	0	0
Diethyl Phthalate	62,783	28,538	10%	25%	30%	2,854	7,134	8,561
Dimethylamine	92,802	42,183	5%	10%	10%	2,109	4,218	4,218
2,4-Dimethyl Phenol	1,739,434	790,652	5%	15%	20%	39,533	118,598	158,130
Dimethyl Phthalate	12,864	5,847	5%	35%	40%	292	2,047	2,339
Di-N-Octyl Phthalate	20,544	9,338	10%	10%	10%	934	934	934
1,4-Dioxane	8,508	3,867	10%	50%	60%	387	1,934	2,320
Diphenyl Amine	0	0	10%	35%	40%	0	0	0
Epichlorohydrin	0	0	13%	41%	75%	0	0	0
Ethylene Oxide	0	0	10%	50%	60%	0	0	0
Formaldehyde	12,557,020	5,707,736	15%	15%	20%	856,160	856,160	1,141,547
Formic Acid	3,192,711	1,451,232	10%	10%	10%	145,123	145,123	145,123
Furan	48,443	22,020	10%	30%	30%	2,202	6,606	6,606
Furfural	8,890,104	4,040,956	10%	40%	50%	404,096	1,616,383	2,020,478
Hexachloro-1,3-Butadiene	0	0	5%	10%	10%	0	0	0
Hexachloroethane	183	83	5%	10%	10%	4	8	8
Hydrazine	4,317	1,962	5%	15%	20%	98	294	392
Naphthalene	2,020,647	918,476	5%	25%	30%	45,924	229,619	275,543
Nickel	3,320,226	1,509,194	65%	65%	65%	980,976	980,976	980,976
2-Nitropropane	0	0	5%	5%	5%	0	0	0

TABLE 4-7. LOADINGS TO SURFACE WATERS BASED ON POTW PASS THROUGH ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated (%)	Unacclimated Range Median (%)	Unacclimated Range Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
N-Nitrosodimethyl Amine	1,208	549	10%	25%	30%	55	137	165
PCB	1,781	810	8%	8%	8%	65	65	65
Pentachloroethane	0	0	5%	25%	30%	0	0	0
Pentachlorophenol	184,321	83,782	5%	75%	80%	4,189	62,837	67,026
Phenol	23,674,543	10,761,156	5%	15%	20%	538,058	1,614,173	2,152,231
Phenylene Diamine	0	0	10%	25%	30%	0	0	0
2-Picoline	0	0	20%	85%	90%	0	0	0
Resorcinol	0	0	5%	25%	30%	0	0	0
Tetrachlorobenzene	0	0	10%	10%	10%	0	0	0
1,1,1,2-Tetrachloroethane	0	0	5%	10%	10%	0	0	0
1,1,2,2-Tetrachloroethane	2,545	1,157	10%	75%	80%	116	868	925
Tetrahydrofuran	3,834,468	1,742,940	5%	25%	30%	87,147	435,735	522,882
Thiourea	0	0	10%	25%	30%	0	0	0
Thiram	0	0	10%	25%	30%	0	0	0
Tribromomethane	27	12	35%	65%	70%	4	8	9
1,2,4-Trichlorobenzene	27,469	12,486	15%	15%	15%	1,873	1,873	1,873
1,1,2-Trichloroethane	278,167	126,440	20%	75%	80%	25,288	94,830	101,152
2,4,6-Trichlorophenol	107,546	48,885	5%	45%	50%	2,444	21,998	24,442
1,2,3-Trichloropropane	0	0	25%	75%	80%	0	0	0
Vinyl Chloride	40,140	18,245	5%	5%	5%	912	912	912
Acenaphthylene	0	0	5%	10%	10%	0	0	0
Acrylamide	6,612	3,005	10%	38%	50%	301	1,142	1,503
Acrylic Acid	29	13	10%	15%	20%	1	2	3
Acrylonitrile	3,282,951	1,492,250	10%	25%	30%	149,225	373,063	447,675
Anthracene	1,445,651	661,660	5%	10%	10%	33,083	66,166	66,166
Benzal Chloride	16,868	7,667	10%	45%	50%	767	3,450	3,834
Benzotrichloride	3,545	1,611	10%	55%	60%	161	886	967
2-Chlorophenol	21,730	9,877	5%	35%	40%	494	3,457	3,951
Dibromomethane	69,727	31,694	15%	20%	20%	4,754	6,339	6,339
3,3-Dimethoxy Benzidine	2,596	1,180	20%	70%	80%	236	826	944
2,4-Dinitrophenol	1,461,989	664,540	10%	25%	30%	66,454	166,135	199,362
Ethylene Thiourea	0	0	15%	33%	40%	0	0	0
Maleic Hydrazide	0	0	10%	25%	30%	0	0	0
Methanethiol	125	57	5%	23%	30%	3	13	17
p-Nitroaniline	127,103	57,774	10%	31%	40%	5,777	17,910	23,110
Phosgene	0	0	0%	0%	0%	0	0	0
Phthalic Anhydride	4,081	1,855	10%	10%	10%	186	186	186
Styrene	0	0	10%	10%	10%	0	0	0
Toluene Diamine	5,988	2,722	10%	25%	30%	272	680	817
Vanadium Pentoxide	905	411	75%	75%	75%	309	309	309
Alachlor	0	0	10%	50%	70%	0	0	0
Aldicarb	0	0	10%	50%	70%	0	0	0

TABLE 4-7. LOADINGS TO SURFACE WATERS BASED ON POTW PASS THROUGH ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated (%)	Unacclimated Range Median (%)	Unacclimated Range Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Aldrin	0	0	10%	10%	10%	0	0	0
Antu	0	0	10%	50%	70%	0	0	0
Atrazine	0	0	10%	65%	70%	0	0	0
Bromacil	0	0	10%	50%	70%	0	0	0
Captan	0	0	10%	50%	70%	0	0	0
Carbofuran	0	0	10%	50%	70%	0	0	0
Chlordane	0	0	10%	10%	10%	0	0	0
Chlorobenzilate	0	0	10%	40%	50%	0	0	0
2,4-D	0	0	10%	40%	50%	0	0	0
2,4-DB	0	0	10%	40%	50%	0	0	0
Diazinon	0	0	10%	40%	50%	0	0	0
Dichlorvos	0	0	10%	50%	70%	0	0	0
Dicofol	0	0	10%	10%	10%	0	0	0
Dinoseb	0	0	10%	60%	70%	0	0	0
Diphenamid	0	0	5%	40%	50%	0	0	0
Disulfolton	0	0	10%	40%	50%	0	0	0
Diuron	0	0	5%	50%	60%	0	0	0
Endrin	0	0	5%	10%	10%	0	0	0
Fenthion	0	0	20%	45%	60%	0	0	0
Ferbam	0	0	10%	45%	60%	0	0	0
Folex	0	0	10%	40%	50%	0	0	0
MCPA	0	0	5%	50%	60%	0	0	0
Methoxychlor	0	0	10%	10%	10%	0	0	0
Mevinphos	0	0	10%	50%	70%	0	0	0
Naled	0	0	20%	50%	70%	0	0	0
Napthalam	0	0	10%	60%	70%	0	0	0
Oxamyl	0	0	10%	50%	70%	0	0	0
Parathion	0	0	100%	45%	60%	0	0	0
Parathion Methyl	0	0	10%	45%	60%	0	0	0
Phorate	0	0	10%	40%	50%	0	0	0
Pyrethrins	0	0	20%	40%	50%	0	0	0
Sodium Fluoroacetate	0	0	5%	50%	70%	0	0	0
Stirofos	0	0	15%	40%	50%	0	0	0
2,4,5-T	0	0	10%	50%	60%	0	0	0
Toxaphene	0	0	5%	10%	10%	0	0	0
Trifluralin	0	0	10%	10%	10%	0	0	0
SUM	203,283,104	92,401,411				7,817,807	16,990,470	20,460,697

TABLE 4-8. LOADINGS TO AIR BASED ON POTW AIR EMISSIONS ANALYSIS

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Released To Air (%)	Unacclimated Release Median (%)	Unacclimated Release Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Acetone	8,317,227	3,780,558	95.0%	50%	30%	0.5%	5%	5%	17,958	94,524	56,708
Arsenic	66,575	30,261	50.0%	50%	50%	0.0%	0%	0%	0	0	0
Barium	0	0	90.0%	90%	90%	0.0%	0%	0%	0	0	0
N-Butyl Alcohol	17,440	7,927	95.0%	90%	90%	0.0%	0%	0%	0	0	0
Cadmium	189,856	86,298	27.0%	27%	27%	0.0%	0%	0%	0	0	0
Carbon Disulfide	0	0	95.0%	85%	80%	80.0%	90%	90%	0	0	0
Carbon Tetrachloride	225,086	102,312	90.0%	85%	80%	80.0%	90%	90%	73,665	78,269	73,665
Chlorobenzene	687,835	312,652	90.0%	90%	90%	30.0%	50%	50%	84,416	140,694	140,694
Chromium	4,660,026	2,118,194	70.0%	70%	70%	0.0%	0%	0%	0	0	0
Cresols	0	0	95.0%	50%	40%	0.0%	0%	0%	0	0	0
Cyclohexanone	1,282,984	583,175	85.0%	50%	30%	0.0%	0%	0%	0	0	0
1,2-Dichlorobenzene	377,071	171,396	90.0%	87%	85%	50.0%	90%	90%	77,128	134,203	131,118
Dichlorodifluoromethane	0	0	95.0%	95%	95%	95.0%	95%	95%	0	0	0
Ethyl Acetate	188,860	85,845	95.0%	90%	90%	0.5%	5%	5%	408	3,863	3,863
Ethyl Benzene	4,802,939	2,183,154	95.0%	90%	90%	25.0%	80%	80%	518,499	1,571,871	1,571,871
Ethyl Ether	0	0	95.0%	50%	30%	10.0%	40%	40%	0	0	0
Isobutanol	0	0	95.0%	90%	90%	0.0%	0%	0%	0	0	0
Lead	3,449,009	1,567,731	70.0%	70%	70%	0.0%	0%	0%	0	0	0
Mercury	42,439	19,290	50.0%	50%	50%	0.5%	5%	5%	48	482	482
Methanol	31,717,755	14,417,161	100.0%	95%	95%	0.5%	5%	5%	72,086	684,815	684,815
Methyl Ethyl Ketone	4,081	1,855	95.0%	50%	30%	0.5%	5%	5%	9	46	28
Methyl Isobutyl Ketone	3,632,156	1,650,980	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Methylene Chloride	12,087,478	5,494,308	95.0%	87%	85%	40.0%	60%	60%	2,087,837	2,868,029	2,802,097
Nitrobenzene	128,085	58,220	90.0%	25%	20%	0.0%	0%	0%	0	0	0
Pyridine	50,021	22,737	15.0%	15%	10%	0.5%	5%	5%	17	171	114
Selenium	142,577	64,808	50.0%	50%	50%	0.0%	0%	0%	0	0	0
Silver	130,587	59,358	90.0%	90%	90%	0.0%	0%	0%	0	0	0
Tetrachloroethylene	3,321,221	1,509,646	90.0%	85%	80%	50.0%	80%	80%	679,341	1,026,559	966,173
Toluene	8,291,692	3,768,951	90.0%	90%	90%	25.0%	80%	80%	895,126	2,713,645	2,713,645
1,1,1-Trichloroethane	8,652,375	3,932,898	95.0%	90%	85%	80.0%	90%	90%	2,989,002	3,185,647	3,008,667
Trichloroethylene	3,803,526	1,728,875	95.0%	87%	85%	70.0%	80%	80%	1,149,702	1,203,297	1,175,635
Trichlorofluoromethane	1,198	545	95.0%	90%	85%	80.0%	90%	90%	414	441	417
1,1,2-TC 1,2,2-TF Ethane	0	0	90.0%	85%	80%	70.0%	80%	80%	0	0	0
Xylenes	15,207,171	6,912,350	95.0%	87%	85%	25.0%	80%	80%	1,641,683	4,810,996	4,700,398
Acetaldehyde	4,545	2,066	95.0%	95%	95%	0.5%	5%	5%	10	98	98
Acetonecyanohydrin	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Acetophenone	0	0	80.0%	50%	30%	0.5%	5%	5%	0	0	0
Acetyl Chloride	0	0	95.0%	50%	30%	0.5%	5%	5%	0	0	0
Acrolein	1,648,576	749,353	95.0%	95%	95%	0.5%	5%	5%	3,559	35,594	35,594
Aniline	5,811,272	2,641,487	95.0%	85%	80%	0.0%	0%	0%	0	0	0
Antimony	221,685	100,766	60.0%	60%	60%	0.0%	0%	0%	0	0	0
Benzene	4,099,249	1,863,295	95.0%	90%	90%	25.0%	80%	80%	442,533	1,341,572	1,341,572
p-Benzoquinone	0	0	95.0%	50%	40%	0.0%	0%	0%	0	0	0
Benzyl Chloride	230,338	104,699	90.0%	90%	90%	25.0%	50%	50%	23,557	47,115	47,115

TABLE 4-8. LOADINGS TO AIR BASED ON POTW AIR EMISSIONS ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Released To Air (%)	Unacclimated Release Median (%)	Unacclimated Release Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
s-2-Chloroethoxy Methane	23	10	10.0%	10%	10%	0.0%	0%	0%	0	0	0
s-2-Chloroethyl Ether	3,480	1,582	90.0%	50%	30%	0.5%	5%	5%	7	40	24
s-2-Ethylhexyl Phthalate	2,660,146	1,209,157	90.0%	90%	90%	0.0%	0%	0%	0	0	0
omomethane	813	370	95.0%	95%	95%	90.0%	95%	95%	316	334	334
tyl Benzyl Phthalate	1,613,930	733,605	95.0%	90%	90%	0.0%	0%	0%	0	0	0
Chloro-m-Cresol	82,918	37,690	95.0%	50%	40%	0.0%	0%	0%	0	0	0
loroethane	15,713	6,897	95.0%	90%	90%	80.0%	90%	90%	5,242	5,586	5,586
oroform	4,189,128	1,904,149	90.0%	80%	80%	70.0%	90%	90%	1,199,614	1,370,987	1,370,987
oromethane	27,230	12,377	95.0%	90%	90%	90.0%	95%	95%	10,583	10,583	10,583
Chloronaphthalene	1,481	673	95.0%	80%	80%	0.5%	5%	5%	3	27	27
mene	174,573	79,351	95.0%	95%	95%	40.0%	60%	60%	30,154	45,230	45,230
anide	3,165,294	1,438,770	60.0%	60%	60%	0.5%	5%	5%	4,316	43,163	43,163
clohexane	0	0	95.0%	95%	95%	10.0%	90%	90%	0	0	0
-N-Butyl Phthalate	85,332	38,787	90.0%	90%	90%	0.0%	0%	0%	0	0	0
3-Dichlorobenzene	7,471	3,396	90.0%	87%	85%	50.0%	90%	90%	1,528	2,659	2,598
4-Dichlorobenzene	583,874	265,397	90.0%	87%	85%	50.0%	90%	90%	119,429	207,806	203,029
1-Dichloroethane	29,666	13,485	90.0%	80%	80%	70.0%	90%	90%	8,495	9,709	9,709
2-Dichloroethane	302,706	137,594	90.0%	50%	30%	50.0%	90%	90%	61,917	61,917	37,150
1-Dichloroethylene	33,224	15,102	95.0%	90%	90%	80.0%	90%	90%	11,477	12,232	12,232
rans-1,2-Dichloroethylene	4,456	2,025	90.0%	80%	80%	70.0%	90%	90%	1,276	1,458	1,458
4-Dichlorophenol	17,453	7,933	95.0%	55%	50%	0.0%	0%	0%	0	0	0
2-Dichloropropane	209,097	95,044	90.0%	70%	70%	50.0%	90%	90%	42,770	59,878	59,878
ichloropropanol	0	0	90.0%	50%	30%	10.0%	50%	50%	0	0	0
ethyl Phthalate	62,783	28,538	90.0%	75%	70%	0.0%	0%	0%	0	0	0
imethylamine	92,802	42,183	95.0%	90%	90%	0.5%	5%	5%	200	1,898	1,898
,4-Dimethyl Phenol	1,739,434	790,652	95.0%	85%	80%	0.0%	0%	0%	0	0	0
imethyl Phthalate	12,864	5,847	95.0%	65%	60%	0.0%	0%	0%	0	0	0
-N-Octyl Phthalate	20,544	9,338	90.0%	90%	90%	0.0%	0%	0%	0	0	0
,4-Dioxane	8,508	3,867	90.0%	50%	40%	0.0%	0%	0%	0	0	0
iphenyl Amine	0	0	90.0%	65%	60%	0.0%	0%	0%	0	0	0
pichlorohydrin	0	0	87.0%	59%	25%	0.0%	0%	0%	0	0	0
thylene Oxide	0	0	90.0%	50%	40%	0.5%	5%	5%	0	0	0
ormaldehyde	12,557,020	5,707,736	85.0%	85%	80%	0.5%	5%	5%	24,258	242,579	228,309
ormic Acid	3,192,711	1,451,232	90.0%	90%	90%	0.5%	5%	5%	6,531	65,305	65,305
uran	48,443	22,020	90.0%	70%	70%	0.5%	5%	5%	99	771	771
urfural	8,890,104	4,040,956	90.0%	60%	50%	0.5%	5%	5%	18,184	121,229	101,024
exachloro-1,3-Butadiene	0	0	95.0%	90%	90%	0.5%	5%	5%	0	0	0
exachloroethane	183	83	95.0%	90%	90%	0.5%	5%	5%	0	4	4
ydrazine	4,317	1,962	95.0%	85%	80%	0.5%	5%	5%	9	83	78
aphthalene	2,020,647	918,476	95.0%	75%	70%	0.5%	5%	5%	4,363	34,443	32,147
ickel	3,320,226	1,509,194	35.0%	35%	35%	0.0%	0%	0%	0	0	0
-Nitropropane	0	0	95.0%	95%	95%	90.0%	95%	95%	0	0	0
N-Nitrosodimethyl Amine	1,208	549	90.0%	75%	70%	0.0%	0%	0%	0	0	0
PCB	1,781	810	92.0%	92%	92%	10.0%	10%	10%	74	74	74

TABLE 4-8. LOADINGS TO AIR BASED ON POTW AIR EMISSIONS ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Released To Air (%)	Unacclimated Release Median (%)	Unacclimated Release Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Pentachloroethane	0	0	95.0%	75%	70%	60.0%	60%	60%	0	0	0
Pentachlorophenol	184,321	83,782	95.0%	25%	20%	0.0%	0%	0%	0	0	0
Phenol	23,674,543	10,761,156	95.0%	85%	80%	0.0%	0%	0%	0	0	0
Phenylene Diamine	0	0	90.0%	75%	70%	0.0%	0%	0%	0	0	0
-Picoline	0	0	80.0%	15%	10%	0.5%	5%	5%	0	0	0
esorcinol	0	0	95.0%	75%	70%	0.0%	0%	0%	0	0	0
Tetrachlorobenzene	0	0	90.0%	90%	90%	30.0%	30%	30%	0	0	0
1,1,1,2-Tetrachloroethane	0	0	95.0%	90%	90%	50.0%	70%	70%	0	0	0
1,1,2,2-Tetrachloroethane	2,545	1,157	90.0%	25%	20%	40.0%	60%	60%	416	174	139
Tetrahydrofuran	3,834,468	1,742,940	95.0%	75%	70%	30.0%	70%	70%	496,738	915,043	854,041
Thiourea	0	0	90.0%	75%	70%	0.0%	0%	0%	0	0	0
Thiram	0	0	90.0%	75%	70%	0.0%	0%	0%	0	0	0
ibromometahne	27	12	65.0%	35%	30%	55.0%	60%	60%	4	3	2
,2,4-Trichlorobenzene	27,469	12,486	85.0%	85%	85%	50.0%	60%	60%	5,307	6,368	6,368
,1,2-Trichloroethane	278,167	126,440	80.0%	25%	20%	50.0%	80%	80%	50,576	25,288	20,230
,4,6-Trichlorophenol	107,546	48,885	95.0%	55%	50%	0.0%	0%	0%	0	0	0
,2,3-Trichloropropane	0	0	75.0%	25%	20%	40.0%	70%	70%	0	0	0
inyl Chloride	40,140	18,245	95.0%	95%	95%	90.0%	95%	95%	15,600	16,467	16,467
cenaphthylene	0	0	95.0%	90%	90%	20.0%	60%	60%	0	0	0
crylamide	6,612	3,005	90.0%	62%	50%	0.0%	0%	0%	0	0	0
crylic Acid	29	13	90.0%	85%	80%	0.0%	0%	0%	0	0	0
Acrylonitrile	3,282,951	1,492,250	90.0%	75%	70%	0.5%	5%	5%	6,715	55,959	52,229
thracene	1,455,651	661,660	95.0%	90%	90%	0.0%	0%	0%	0	0	0
nzal Chloride	16,868	7,667	90.0%	55%	50%	0.0%	30%	30%	0	1,265	1,150
enzotrichloride	3,545	1,611	90.0%	45%	40%	20.0%	30%	30%	290	218	193
-Chlorophenol	21,730	9,877	95.0%	65%	60%	0.0%	0%	0%	0	0	0
Dibromomethane	69,727	31,694	85.0%	80%	80%	50.0%	80%	80%	13,470	20,284	20,284
3,3-Dimethoxy benzidine	2,596	1,180	80.0%	30%	20%	0.0%	0%	0%	0	0	0
2,4-Dinitrophenol	1,461,989	664,540	90.0%	75%	70%	0.0%	0%	0%	0	0	0
Ethylene Thiourea	0	0	85.0%	67%	60%	0.0%	0%	0%	0	0	0
Maleic Hydrazide	0	0	90.0%	75%	70%	0.0%	0%	0%	0	0	0
ethanethiol	125	57	95.0%	77%	70%	40.0%	60%	60%	22	26	24
-Nitroaniline	127,103	57,774	90.0%	69%	60%	0.0%	0%	0%	0	0	0
Phosgene	0	0	100.0%	100%	100%	0.5%	5%	5%	0	0	0
hthalic Anhydride	4,081	1,855	90.0%	90%	90%	0.0%	0%	0%	0	0	0
tyrene	0	0	90.0%	90%	90%	25.0%	80%	80%	0	0	0
Toluene Diamine	5,988	2,722	90.0%	75%	70%	0.0%	0%	0%	0	0	0
Vanadium Pentoxide	905	411	25.0%	25%	25%	0.0%	0%	0%	0	0	0
Alachlor	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Aldicarb	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Aldrin	0	0	90.0%	90%	90%	0.0%	0%	0%	0	0	0
Antu	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Atrazine	0	0	90.0%	35%	30%	0.0%	0%	0%	0	0	0
Bromacil	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0

TABLE 4-8. LOADINGS TO AIR BASED ON POTW AIR EMISSIONS ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Released To Air (%)	Unacclimated Release Median (%)	Unacclimated Release Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Captan	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Carbofuran	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Chlordane	0	0	90.0%	90%	90%	10.0%	10%	10%	0	0	0
Chlorobenzilate	0	0	90.0%	60%	50%	10.0%	10%	10%	0	0	0
2,4-D	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
2,4-DB	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
Diazinon	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
Dichlorvos	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Dicofol	0	0	90.0%	90%	90%	50.0%	50%	50%	0	0	0
Dinoseb	0	0	90.0%	40%	30%	0.0%	0%	0%	0	0	0
Diphenamid	0	0	95.0%	60%	50%	0.0%	0%	0%	0	0	0
Disulfoton	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
Diuron	0	0	95.0%	50%	40%	0.0%	0%	0%	0	0	0
Endrin	0	0	95.0%	90%	90%	0.0%	0%	0%	0	0	0
Fenthion	0	0	80.0%	55%	40%	0.0%	0%	0%	0	0	0
Ferbam	0	0	90.0%	55%	40%	0.0%	0%	0%	0	0	0
Folex	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
MCPA	0	0	95.0%	50%	40%	0.0%	0%	0%	0	0	0
Methoxychlor	0	0	90.0%	90%	90%	60.0%	60%	60%	0	0	0
Mevinphos	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Naled	0	0	80.0%	50%	30%	0.0%	0%	0%	0	0	0
Napthalam	0	0	90.0%	40%	30%	0.0%	0%	0%	0	0	0
Oxamyl	0	0	90.0%	50%	30%	0.0%	0%	0%	0	0	0
Parathion	0	0	0.0%	55%	40%	0.0%	0%	0%	0	0	0
Parathion Methyl	0	0	90.0%	55%	40%	0.0%	0%	0%	0	0	0
Phorate	0	0	90.0%	60%	50%	0.0%	0%	0%	0	0	0
Pyrethrins	0	0	80.0%	60%	50%	0.0%	0%	0%	0	0	0
Sodium Fluoroacetate	0	0	95.0%	50%	30%	0.0%	0%	0%	0	0	0
Stirofos	0	0	85.0%	60%	50%	0.0%	0%	0%	0	0	0
2,4,5-T	0	0	90.0%	50%	40%	0.0%	0%	0%	0	0	0
Toxaphene	0	0	95.0%	90%	90%	60.0%	80%	80%	0	0	0
Trifluralin	0	0	90.0%	90%	90%	0.0%	0%	0%	0	0	0
SUM	203,283,104	92,401,411							12,896,981	23,281,011	22,657,495

volatilization fractions to correct these loadings could not be performed at this time.

Table 4-9 presents the estimated loadings of DSS pollutants that are expected to partition to the sludge. Due to the extrapolation of the average partition fractions from the eight Henry's Law Constant/Partition Coefficient groups to those DSS pollutants that do not have actual partition fractions, higher or lower loadings to the sludge may be predicted for certain pollutants than may occur for actual National loadings. This problem is discussed further in Chapter 5.

TABLE 4-9. LOADINGS TO SLUDGE BASED ON POTW SLUDGE PARTITIONING ANALYSIS

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Transfer To Sludge (%)	Unacclimated Transfer Median (%)	Unacclimated Transfer Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Acetone	8,317,227	3,780,558	95.0%	50%	30%	10%	10%	10%	359,153	189,028	113,417
Arsenic	66,575	30,261	50.0%	50%	50%	100%	100%	100%	15,131	15,131	15,131
Barium	0	0	90.0%	90%	90%	100%	100%	100%	0	0	0
N-Butyl Alcohol	17,440	7,927	95.0%	90%	90%	10%	10%	10%	753	713	713
Cadmium	189,856	86,298	27.0%	27%	27%	100%	100%	100%	23,301	23,301	23,301
Carbon Disulfide	0	0	95.0%	85%	80%	1%	1%	1%	0	0	0
Carbon Tetrachloride	225,086	102,312	90.0%	85%	80%	13%	10%	10%	11,970	8,697	8,185
Chlorobenzene	687,835	312,652	90.0%	90%	90%	15%	15%	15%	42,208	42,208	42,208
Chromium	4,660,026	2,118,194	70.0%	70%	70%	100%	100%	100%	1,482,736	1,482,736	1,482,736
Cresols	0	0	95.0%	50%	40%	8%	8%	8%	0	0	0
Cyclohexane	1,282,984	583,175	85.0%	50%	30%	10%	10%	10%	49,570	29,159	17,459
1,2-Dichlorobenzene	377,071	171,396	90.0%	87%	85%	35%	10%	10%	53,990	14,911	14,569
Dichlorodifluoromethane	0	0	95.0%	95%	95%	0%	0%	0%	0	0	0
Ethyl Acetate	188,860	85,845	95.0%	90%	90%	10%	10%	10%	8,155	7,726	7,726
Ethyl Benzene	4,802,939	2,183,154	95.0%	90%	90%	6%	6%	6%	124,440	117,890	117,890
Ethyl Ether	0	0	95.0%	50%	30%	10%	10%	10%	0	0	0
Isobutanol	0	0	95.0%	90%	90%	10%	10%	10%	0	0	0
Lead	3,449,009	1,567,731	70.0%	70%	70%	100%	100%	100%	1,097,412	1,097,412	1,097,412
Mercury	42,439	19,290	50.0%	50%	50%	95%	95%	95%	9,163	9,163	9,163
Methanol	31,717,755	14,417,161	100.0%	95%	95%	10%	10%	10%	1,441,716	1,369,630	1,369,630
Methyl Ethyl Ketone	4,081	1,855	95.0%	50%	30%	10%	10%	10%	176	93	56
Methyl Isobutyl Ketone	3,632,156	1,650,980	90.0%	50%	30%	10%	10%	10%	148,588	82,549	49,529
Methylene Chloride	12,087,478	5,494,308	95.0%	87%	85%	14%	14%	14%	730,743	669,207	653,823
Nitrobenzene	128,085	58,220	90.0%	25%	20%	10%	10%	10%	5,240	1,456	1,164
Pyridine	50,021	22,737	15.0%	15%	10%	10%	10%	10%	341	341	227
Selenium	142,577	64,808	50.0%	50%	50%	100%	100%	100%	32,404	32,404	32,404
Silver	130,587	59,358	90.0%	90%	90%	100%	100%	100%	53,422	53,422	53,422
Tetrachloroethylene	3,321,221	1,509,646	90.0%	85%	80%	3%	3%	3%	40,760	38,496	36,232
Toluene	8,291,692	3,768,951	95.0%	90%	90%	28%	20%	20%	1,002,541	678,411	678,411
1,1,1-Trichloroethane	8,652,375	3,932,898	95.0%	90%	85%	1%	1%	1%	37,363	35,396	33,430
Trichloroethylene	3,803,526	1,728,875	95.0%	87%	85%	6%	6%	6%	98,546	90,247	88,173
Trichlorofluoromethane	1,198	545	95.0%	90%	85%	0%	0%	0%	0	0	0
1,1,2-TC 1,2,2-TF Ethane	0	0	90.0%	85%	80%	4%	4%	4%	0	0	0
Xylenes	15,207,171	6,912,350	95.0%	87%	85%	15%	15%	15%	985,010	902,062	881,325
Acetaldehyde	4,545	2,066	95.0%	95%	95%	10%	10%	10%	196	196	196
Acetonecyanohydrin	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Acetophenone	0	0	80.0%	50%	30%	10%	10%	10%	0	0	0
Acetyl Chloride	0	0	95.0%	50%	30%	10%	10%	10%	0	0	0
Acrolein	1,648,576	749,353	95.0%	95%	95%	10%	10%	10%	71,189	71,189	71,189
Aniline	5,811,272	2,641,487	95.0%	85%	80%	10%	10%	10%	250,941	224,526	211,319
Antimony	221,685	100,766	60.0%	60%	60%	100%	100%	100%	60,460	60,460	60,460
Benzene	4,099,249	1,863,295	95.0%	90%	90%	2%	2%	2%	35,403	33,539	33,539
p-Benzoquinone	0	0	95.0%	50%	40%	8%	8%	8%	0	0	0
Benzyl Chloride	230,338	104,699	90.0%	90%	90%	8%	8%	8%	7,538	7,538	7,538

TABLE 4-9. LOADINGS TO SLUDGE BASED ON POTW SLUDGE PARTITIONING ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Transfer To Sludge (%)	Unacclimated Transfer Median (%)	Unacclimated Transfer Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Bis-2-Chloroethoxy Methane	23	10	10.0%	10%	10%	10%	10%	10%	0	0	0
Bis-2-Chloroethyl Ether	3,480	1,582	90.0%	50%	30%	10%	10%	10%	142	79	47
Bis-2-Ethylhexyl Phthalate	2,660,146	1,209,157	90.0%	90%	90%	73%	73%	73%	794,416	794,416	794,416
Bromomethane	813	370	95.0%	95%	95%	0%	0%	0%	0	0	0
Butyl Benzyl Phthalate	1,613,930	733,605	95.0%	90%	90%	45%	45%	45%	313,616	297,110	297,110
p-Chloro-m-Cresol	82,918	37,690	95.0%	50%	40%	8%	8%	8%	2,864	1,508	1,206
Chloroethane	15,173	6,897	95.0%	90%	90%	1%	1%	1%	66	62	62
Chloroform	4,189,128	1,904,149	90.0%	80%	80%	2%	2%	2%	34,275	30,466	30,466
Chloromethane	27,230	12,377	95.0%	90%	90%	1%	1%	1%	118	111	111
2-Chloronaphthalene	1,481	673	95.0%	80%	80%	37%	37%	37%	237	199	199
Cumene	174,573	79,351	95.0%	95%	95%	4%	4%	4%	3,015	3,015	3,015
Cyanide	3,165,294	1,438,770	60.0%	60%	60%	95%	95%	95%	820,099	820,099	820,099
Cyclohexane	0	0	95.0%	95%	95%	4%	4%	4%	0	0	0
Di-N-Butyl Phthalate	85,332	38,787	90.0%	90%	90%	22%	22%	22%	7,680	7,680	7,680
1,3-Dichlorobenzene	7,471	3,396	90.0%	87%	85%	3%	3%	3%	92	89	87
1,4-Dichlorobenzene	583,874	265,397	90.0%	87%	85%	25%	10%	10%	59,714	23,090	22,559
1,1-Dichloroethane	29,666	13,485	90.0%	80%	80%	0%	0%	0%	0	0	0
1,2-Dichloroethane	302,706	137,594	90.0%	50%	30%	5%	5%	5%	6,192	3,440	2,064
1,1-Dichloroethylene	33,224	15,102	95.0%	90%	90%	0%	0%	0%	0	0	0
Trans-1,2-Dichloroethylene	4,456	2,025	90.0%	80%	80%	30%	10%	10%	547	162	162
2,4-Dichlorophenol	17,453	7,933	95.0%	55%	50%	8%	8%	8%	603	349	317
1,2-Dichloropropane	209,097	95,044	90.0%	70%	70%	0%	0%	0%	0	0	0
Dichloropropanol	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Diethyl Phthalate	62,783	28,538	90.0%	75%	70%	1%	1%	1%	257	214	200
Dimethylamine	92,802	42,183	95.0%	90%	90%	10%	10%	10%	4,007	3,796	3,796
2,4-Dimethyl Phenol	1,739,434	790,652	95.0%	85%	80%	8%	8%	8%	60,090	53,764	50,602
Dimethyl Phthalate	12,864	5,847	95.0%	65%	60%	0%	0%	0%	0	0	0
Di-N-Octyl Phthalate	20,544	9,338	90.0%	90%	90%	8%	8%	8%	672	672	672
1,4-Dioxane	8,508	3,867	90.0%	50%	40%	10%	10%	10%	348	193	155
Diphenyl Amine	0	0	90.0%	65%	60%	8%	8%	8%	0	0	0
Epichlorohydrin	0	0	87.0%	59%	25%	10%	10%	10%	0	0	0
Ethylene Oxide	0	0	90.0%	50%	40%	10%	10%	10%	0	0	0
Formaldehyde	12,557,020	5,707,736	85.0%	85%	80%	10%	10%	10%	485,158	485,158	456,619
Formic Acid	3,192,711	1,451,232	90.0%	90%	90%	10%	10%	10%	130,611	130,611	130,611
Furan	48,443	22,020	90.0%	70%	70%	14%	14%	14%	2,774	2,158	2,158
Furfural	8,890,104	4,040,956	90.0%	60%	50%	10%	10%	10%	363,686	242,457	202,048
Hexachloro-1,3-Butadiene	0	0	95.0%	90%	90%	9%	9%	9%	0	0	0
Hexachloroethane	183	83	95.0%	90%	90%	9%	9%	9%	7	7	7
Hydrazine	4,317	1,962	95.0%	85%	80%	10%	10%	10%	186	167	157
Naphthalene	2,020,647	918,476	95.0%	75%	70%	28%	28%	28%	244,315	192,880	180,021
Nickel	3,320,226	1,509,194	35.0%	35%	35%	100%	100%	100%	528,218	528,218	528,218
2-Nitropropane	0	0	95.0%	95%	95%	1%	1%	1%	0	0	0
N-Nitrosodimethyl Amine	1,208	549	90.0%	75%	70%	10%	10%	10%	49	41	38
PCB	1,781	810	92.0%	92%	92%	24%	24%	24%	179	179	179
Pentachloroethane	0	0	95.0%	75%	70%	15%	15%	15%	0	0	0

TABLE 4-9. LOADINGS TO SLUDGE BASED ON POTW SLUDGE PARTITIONING ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Transfer To Sludge (%)	Unacclimated Transfer Median (%)	Unacclimated Transfer Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Pentachlorophenol	184,321	83,782	95.0%	25%	20%	18%	18%	18%	14,327	3,770	3,016
Phenol	23,674,543	10,761,156	95.0%	85%	80%	15%	15%	15%	1,533,465	1,372,047	1,291,339
Phenylene Diamine	0	0	90.0%	75%	70%	10%	10%	10%	0	0	0
2-Picoline	0	0	80.0%	15%	10%	10%	10%	10%	0	0	0
Resorcinol	0	0	95.0%	75%	70%	10%	10%	10%	0	0	0
Tetrachlorobenzene	0	0	90.0%	90%	90%	37%	37%	37%	0	0	0
1,1,1,2-Tetrachloroethane	0	0	95.0%	90%	90%	4%	4%	4%	0	0	0
1,1,2,2-Tetrachloroethane	2,545	1,157	90.0%	25%	20%	4%	4%	4%	42	12	9
Tetrahydrofuran	3,834,468	1,742,940	95.0%	75%	70%	10%	10%	10%	165,579	130,721	122,006
Thiourea	0	0	90.0%	75%	70%	10%	10%	10%	0	0	0
Thiram	0	0	90.0%	75%	70%	10%	10%	10%	0	0	0
Tribromomethane	27	12	65.0%	35%	30%	8%	8%	8%	1	0	0
1,2,4-Trichlorobenzene	27,469	12,486	85.0%	85%	85%	9%	9%	9%	955	955	955
1,1,2-Trichloroethane	278,167	126,440	80.0%	25%	20%	0%	0%	0%	0	0	0
2,4,6-Trichlorophenol	107,546	48,885	95.0%	55%	50%	8%	8%	8%	3,715	2,151	1,955
1,2,3-Trichloropropane	0	0	75.0%	25%	20%	8%	8%	8%	0	0	0
Vinyl Chloride	40,140	18,245	95.0%	95%	95%	2%	2%	2%	347	347	347
Acenaphthylene	0	0	95.0%	90%	90%	9%	9%	9%	0	0	0
Acrylamide	6,612	3,005	90.0%	62%	50%	10%	10%	10%	270	186	150
Acrylic Acid	29	13	90.0%	85%	80%	10%	10%	10%	1	1	1
Acrylonitrile	3,282,951	1,492,250	90.0%	75%	70%	10%	10%	10%	134,303	111,919	104,458
Anthracene	1,455,651	661,660	95.0%	90%	90%	55%	55%	55%	345,717	327,521	327,521
Benzal Chloride	16,868	7,667	90.0%	55%	50%	8%	8%	8%	552	337	307
Benzotrichloride	3,545	1,611	90.0%	45%	40%	8%	8%	8%	116	58	52
2-Chlorophenol	21,730	9,877	95.0%	65%	60%	8%	8%	8%	751	514	474
Dibromomethane	69,727	31,694	85.0%	80%	80%	15%	15%	15%	4,041	3,803	3,803
3,3-Dimethoxy benzidine	2,596	1,180	80.0%	30%	20%	10%	10%	10%	94	35	24
2,4-Dinitrophenol	1,461,989	664,540	90.0%	75%	70%	10%	10%	10%	59,809	49,841	46,518
Ethylene Thiourea	0	0	85.0%	67%	60%	10%	10%	10%	0	0	0
Maleic Hydrazide	0	0	90.0%	75%	70%	10%	10%	10%	0	0	0
Methanethiol	125	57	95.0%	77%	70%	10%	10%	10%	5	4	4
p-Nitroaniline	127,103	57,774	90.0%	69%	60%	10%	10%	10%	5,200	3,986	3,466
Phosgene	0	0	100.0%	100%	100%	10%	10%	10%	0	0	0
Phthalic anhydride	4,081	1,855	90.0%	90%	90%	10%	10%	10%	167	167	167
Styrene	0	0	90.0%	90%	90%	15%	15%	15%	0	0	0
Toluene Diamine	5,988	2,722	90.0%	75%	70%	10%	10%	10%	245	204	191
Vanadium Pentoxide	905	411	25.0%	25%	25%	10%	10%	10%	10	10	10
Alachlor	0	0	90.0%	50%	30%	8%	8%	8%	0	0	0
Aldicarb	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Aldrin	0	0	90.0%	90%	90%	37%	37%	37%	0	0	0
Antu	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Atrazine	0	0	90.0%	35%	30%	8%	8%	8%	0	0	0
Bromacil	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Captan	0	0	90.0%	50%	30%	8%	8%	8%	0	0	0
Carbofuran	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0

TABLE 4-9. LOADINGS TO SLUDGE BASED ON POTW SLUDGE PARTITIONING ANALYSIS (Continued)

Pollutant	Loading (lb/yr)	Loading (kg/yr)	Acclimated Removal (%)	Unacclimated Removal Median (%)	Unacclimated Removal Low (%)	Transfer To Sludge (%)	Unacclimated Transfer Median (%)	Unacclimated Transfer Low (%)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Chlordane	0	0	90.0%	90%	90%	37%	37%	37%	0	0	0
Chlorobenzilate	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
2,4-D	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
2,4-DB	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
Diazinon	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
Dichlorvos	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Dicofol	0	0	90.0%	90%	90%	9%	9%	9%	0	0	0
Dinoseb	0	0	90.0%	40%	30%	8%	8%	8%	0	0	0
Diphenamid	0	0	95.0%	60%	50%	8%	8%	8%	0	0	0
Disulfolton	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
Diuron	0	0	95.0%	50%	40%	8%	8%	8%	0	0	0
Endrin	0	0	95.0%	90%	90%	37%	37%	37%	0	0	0
Fenthion	0	0	80.0%	55%	40%	8%	8%	8%	0	0	0
Ferbam	0	0	90.0%	55%	40%	8%	8%	8%	0	0	0
Folex	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
MCPA	0	0	95.0%	50%	40%	8%	8%	8%	0	0	0
Methoxychlor	0	0	90.0%	90%	90%	9%	9%	9%	0	0	0
Mevinphos	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Naled	0	0	80.0%	50%	30%	10%	10%	10%	0	0	0
Napthalam	0	0	90.0%	40%	30%	10%	10%	10%	0	0	0
Oxamyl	0	0	90.0%	50%	30%	10%	10%	10%	0	0	0
Parathion	0	0	0.0%	55%	40%	8%	8%	8%	0	0	0
Parathion Methyl	0	0	90.0%	55%	40%	8%	8%	8%	0	0	0
Phorate	0	0	90.0%	60%	50%	8%	8%	8%	0	0	0
Pyrethrins	0	0	80.0%	60%	50%	8%	8%	8%	0	0	0
Sodium Fluoroacetate	0	0	95.0%	50%	30%	10%	10%	10%	0	0	0
Stirofos	0	0	85.0%	60%	50%	8%	8%	8%	0	0	0
2,4,5-T	0	0	90.0%	50%	40%	8%	8%	8%	0	0	0
Toxaphene	0	0	95.0%	90%	90%	4%	4%	4%	0	0	0
Trifluralin	0	0	90.0%	90%	90%	37%	37%	37%	0	0	0
SUM	203,283,104	92,401,411							14,414,502	13,020,218	12,653,867

CHAPTER 5

EFFECTS OF DISCHARGES OF DOMESTIC SEWAGE STUDY POLLUTANTS TO POTWs

5. EFFECTS OF DISCHARGES OF DOMESTIC SEWAGE STUDY POLLUTANTS TO POTWS

5.1 INTRODUCTION

The purpose of this chapter is to document the potential for environmental effects that result from the discharge, emission, and/or leaching of DSS pollutants that are received for treatment by POTWs. Given that POTW and EPA influent and effluent sampling efforts normally have been limited to the 126 priority pollutants identified under the NPDES program, this chapter's documentation of potential effects has been limited largely to those priority pollutants.

In lieu of being able to draw an exact cause-effect relationship among discharge, emission, and leaching of DSS pollutants and environmental effects (a difficult task even with complete data), an analysis was conducted of potential effects on environmental media based on projected loadings, pollutant characteristics, projected criteria exceedances, and related case studies. A summary of the approach and the limitations in using this approach are described below.

5.1.1 National Estimates of DSS Pollutant Releases

Based on the analyses discussed in Chapters 3 and 4 of this study, Table 5-1 was produced, which shows the expected National loadings of DSS pollutants (except pesticides) to water, air, and sludge. (Pesticide loadings numbers are not included in this table due to the proprietary nature of the data.) The table was produced by using the current discharge loadings that were generated in the Chapter 3 industry assessment. With the exception of three metals, if a discrepancy in loadings existed between the ISDB and ITD data base, the higher of the two values was selected for use in Table 5-1. Influent loadings appear in the left column of the table. The difference between the influent loadings and the three media for organic chemicals was assumed to result from biodegradable pollutants. Loadings to each medium were calculated for three separate scenarios: acclimated loadings, median estimated unacclimated loadings, and low estimated unacclimated loadings. As an example, roughly 1.9 million kg/year of chloroform are received at POTWs, and the unacclimated median loadings to the receiving media are approximately 381,000

TABLE 5-1. LOADINGS OF DSS POLLUTANTS TO POTW AND RESULTANT RECEIVING ENVIRONMENTS

		LOADINGS TO RECEIVING WATERS			LOADINGS TO AIR			LOADINGS TO SLUDGE		
Pollutant	Estimated National Loading (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Loading Median (kg/yr)	Unacclimated Loading Low (kg/yr)
Acetone	3,780,558	189,028	1,890,279	2,646,390	17,958	94,514	56,708	359,153	189,028	113,417
Arsenic	30,261	15,131	15,131	15,131	0	0	0	15,131	15,131	15,131
Barium	N.A.*									
N-Butyl Alcohol	7,927	396	793	793	0	0	0	753	713	713
Cadmium	86,298	62,998	62,998	62,998	0	0	0	23,301	23,301	23,301
Carbon Disulfide	N.A.									
Carbon Tetrachloride	102,312	10,231	15,347	20,462	73,665	78,269	73,665	11,970	8,697	8,185
Chlorobenzene	312,652	31,265	31,265	31,265	84,416	140,694	140,694	42,208	42,208	42,208
Chromium	2,118,194	635,458	635,458	635,458	0	0	0	1,482,736	1,482,736	1,482,736
Cresols	N.A.									
Cyclohexanone	583,175	87,476	291,587	408,222	0	0	0	49,570	29,159	17,495
1,2-Dichlorobenzene	171,396	17,140	22,281	25,709	77,128	134,203	131,118	53,990	14,911	14,569
Dichlorodifluoromethane	0	0	0	0	0	0	0	0	0	0
Ethyl Acetate	85,845	4,292	8,585	8,585	408	3,863	3,863	8,155	7,726	7,726
Ethyl Benzene	2,183,154	109,158	218,315	218,315	518,499	1,571,871	1,571,871	124,440	117,890	117,890
Ethyl Ether	N.A.									
Isobutanol	N.A.									
Lead	1,567,731	470,319	470,319	470,319	0	0	0	1,097,412	1,097,412	1,097,412
Mercury	19,290	9,645	9,645	9,645	48	482	482	9,163	9,163	9,163
Methanol	14,417,161	0	720,858	720,858	72,086	684,815	684,815	1,441,716	1,369,630	1,369,630
Methyl Ethyl Ketone	1,855	93	928	1,299	9	46	28	176	93	56
Methyl Isobutyl Ketone	1,650,980	165,098	825,490	1,155,686	0	0	0	148,588	82,549	49,529
Methylene Chloride	5,494,308	274,715	714,260	824,146	2,087,837	2,868,029	2,802,097	730,743	669,207	653,823
Nitrobenzene	58,220	5,822	43,665	46,576	0	0	0	5,240	1,456	1,164
Pyridine	22,737	19,236	19,326	20,463	17	171	114	341	341	227
Selenium	64,808	32,404	32,404	32,404	0	0	0	32,404	32,404	32,404
Silver	59,358	5,936	5,936	5,936	0	0	0	53,422	53,422	53,422
Tetrachloroethylene	1,509,646	150,965	226,447	301,929	679,341	1,026,559	966,173	40,760	38,496	36,232
Toluene	3,768,951	188,448	376,895	376,895	895,126	2,713,645	2,713,645	1,002,541	678,411	678,411
1,1,1-Trichloroethane	3,932,898	196,645	393,290	589,935	2,989,002	3,185,647	3,008,667	37,363	35,396	33,430
Trichloroethylene	1,728,875	86,444	224,754	259,331	1,149,702	1,203,297	1,175,635	98,546	90,247	88,173
Trichlorofluoromethane	545	27	54	82	414	441	417	0	0	0
1,1,2-TC 1,2,2-TF Ethane	N.A.									
Xylenes	6,912,350	345,618	898,606	1,036,853	1,641,683	4,180,996	4,700,398	985,010	902,062	881,325
Acetaldehyde	2,066	103	103	103	10	98	98	196	196	196
Acetomecyanohydrin	N.A.									
Acetophenone	N.A.									
Acetyl Chloride	N.A.									
Acrolein	749,353	37,468	37,468	37,468	3,559	35,594	35,594	71,189	71,189	71,189
Aniline	2,641,487	132,074	396,223	528,297	0	0	0	250,941	224,526	211,319
Antimony	100,766	40,306	40,306	40,306	0	0	0	60,460	60,460	60,460
Benzene	1,863,295	93,165	186,330	186,330	442,533	1,341,572	1,341,572	35,403	33,539	33,539
p-Benzoquinone	N.A.									
Benzyl Chloride	104,699	10,470	10,470	10,470	23,557	47,115	47,115	7,538	7,538	7,538

*N.A. - Data Not Available.

TABLE 5-1. LOADINGS OF DSS POLLUTANTS TO POTW AND RESULTANT RECEIVING ENVIRONMENTS (Continued)

		LOADINGS TO RECEIVING WATERS			LOADINGS TO AIR			LOADINGS TO SLUDGE		
			Unacclimated Release			Unacclimated Loading			Unacclimated Loading	
Pollutant	Loading (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)
Bis-2-Chloroethoxy Methane	0	0	0	0	0	0	0	0	0	0
Bis-2-Chloroethyl Ether	0	0	0	0	0	0	0	0	0	0
Bis-2-Ethylhexyl Phthalate	1,209,157	120,916	120,916	120,916	0	0	0	444,546	444,546	444,546
Bromomethane	370	18	18	18	316	334	334	0	0	0
Butyl Benzyl Phthalate	733,605	36,680	73,360	73,360	0	0	0	287,252	272,133	272,133
p-Chloro-m-Cresol	37,690	1,885	18,845	22,614	0	0	0	0	0	0
Chlorethane	6,897	345	690	690	5,242	5,586	5,586	66	62	62
Chloroform	1,904,144	190,414	380,829	380,829	1,199,610	1,370,983	1,370,983	14,142	12,571	12,571
Chloromethane	14,167	708	1,417	1,417	12,113	12,113	12,113	135	128	128
2-Chloronapthalene	24	1	5	5	1	1	1	8	7	7
Cumene	79,351	3,968	3,968	3,968	30,154	45,230	45,230	3,015	3,015	3,015
Cyanide	1,439,410	143,941	143,941	143,941	0	0	0	1,295,469	1,295,469	1,295,469
Cyclohexane	0	0	0	0	0	0	0	0	0	0
Di-N-Butyl Phthalate	38,787	3,879	3,879	3,879	0	0	0	100	100	100
1,3-Dichlorbenzene	3,396	340	441	509	1,528	2,659	2,598	11	11	11
1,4-Dichlorbenzene	265,397	26,540	34,502	39,810	119,429	207,806	203,029	57,470	55,554	54,277
1,1-Dichlorethane	13,485	1,348	2,697	2,697	8,495	9,709	9,709	0	0	0
1,2-Dichlorethane	137,933	13,793	68,966	96,553	62,070	62,070	37,242	868	482	289
1,1-Dichlorethylene	15,530	776	1,553	1,553	11,802	12,579	12,579	0	0	0
Trans-1,2-Dichlorethylene	2,025	203	405	405	1,276	1,458	1,458	135	120	120
2,4-Dichlorophenol	12,838	642	5,777	6,419	0	0	0	816	472	430
1,2-Dichloropropane	95,044	9,504	28,513	28,513	42,770	59,878	59,878	0	0	0
Dichloropropanol	0	0	0	0	0	0	0	0	0	0
Diethyl Phthalate	28,538	2,854	7,134	8,561	0	0	0	12	10	9
Dimethylamine	42,183	2,109	4,218	4,218	2,004	1,898	1,898	4,007	3,796	3,796
2,4-Dimethyl Phenol	790,652	39,533	118,598	158,130	0	0	0	56,890	50,901	47,907
Dimethyl Phthalate	5,847	292	2,047	2,339	0	0	0	0	0	0
Di-N-Octyl Phthalate	9,338	934	934	934	0	0	0	0	0	0
1,4-Dioxane	3,757	376	879	2,254	0	0	0	338	188	150
Diphenyl Amine	0	0	0	0	0	0	0	0	0	0
Epichlorophydrin	0	0	0	0	0	0	0	0	0	0
Ethylene Oxide	0	0	0	0	0	0	0	0	0	0
Formaldehyde	5,707,736	856,160	856,160	1,141,547	242,579	242,579	228,309	485,158	485,158	456,619
Formic Acid	1,451,232	145,123	145,123	145,123	65,305	65,305	65,305	130,611	130,611	130,611
Furan	22,020	2,202	6,606	6,606	991	771	771	2,774	2,158	2,158
Furfural	4,040,956	404,096	1,616,383	2,020,478	181,843	121,229	101,024	363,686	242,457	202,048
Hexachlor-1,3-Butadiene	0	0	0	0	0	0	0	0	0	0
Hexachloroethane	0	0	0	0	0	0	0	0	0	0
Hydrazine	1,869	93	280	374	89	79	75	178	159	150
Napthalene	918,476	45,924	229,619	275,543	43,628	34,443	32,147	194,713	153,721	143,473
Nickel	1,431,256	930,317	930,317	930,317	0	0	0	500,939	500,939	500,939
2-Nitropropane	0	0	0	0	0	0	0	0	0	0
N-Nitrosodimethyl Amine	549	55	137	165	0	0	0	0	0	0
PCB	293	23	23	23	27	27	27	65	65	65

TABLE 5-1. LOADINGS OF DSS POLLUTANTS TO POTW AND RESULTANT RECEIVING ENVIRONMENTS (Continued)

		LOADINGS TO RECEIVING WATERS			LOADINGS TO AIR			LOADINGS TO SLUDGE		
Pollutant	Loading (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Median (kg/yr)	Release Low (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Median (kg/yr)	Loading Low (kg/yr)	Acclimated Loading (kg/yr)	Unacclimated Median (kg/yr)	Loading Low (kg/yr)
Pentachlorethane	0	0	0	0	0	0	0	0	0	0
Pentachlorophenol	83,781	4,189	62,836	67,025	0	0	0	1,141	300	240
Phenol	10,761,152	538,058	1,614,173	2,152,230	0	0	0	1,436,125	1,284,954	1,209,368
Phenylene Diamine	0	0	0	0	0	0	0	0	0	0
2-Picoline	0	0	0	0	0	0	0	0	0	0
Resorcinol	0	0	0	0	0	0	0	0	0	0
Tetrachlorobenzene	0	0	0	0	0	0	0	0	0	0
1,1,1,2-Tetrachloroethane	0	0	0	0	0	0	0	0	0	0
1,1,2,2-Tetrachloroethane	1,157	116	868	925	416	174	139	0	0	0
Tetrahydrofuran	1,742,940	87,147	435,735	522,882	496,738	915,043	854,041	165,579	130,721	122,006
Thiourea	0	0	0	0	0	0	0	0	0	0
Thiram	0	0	0	0	0	0	0	0	0	0
Tribromomethane	12	4	8	9	4	3	2	0	0	0
1,2,4-Trichlorobenzene	12,486	1,873	1,873	1,873	5,307	6,368	6,368	808	808	808
1,1,2-Trichloroethane	126,440	25,288	94,830	101,152	50,576	25,288	20,230	0	0	0
2,4,6-Trichlorophenol	48,902	2,445	22,006	24,451	0	0	0	7	4	4
1,2,3-Trichloropropane	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	18,245	912	912	912	15,600	16,467	16,467	346	346	346
Acenaphthylene	0	0	0	0	0	0	0	0	0	0
Acrylamide	3,005	301	1,142	1,503	0	0	0	270	186	150
Acrylic Acid	13	1	2	3	0	0	0	1	1	1
Acrylonitrile	1,492,250	492,250	373,063	447,675	0	55,959	52,229	0	111,919	104,458
Anthracene	661,660	33,083	66,166	66,166	0	0	0	345,717	327,521	327,521
Benzal Chloride	104,699	10,470	47,115	52,350	0	17,275	15,705	7,538	4,607	4,188
Benzotrichloride	1,611	161	886	967	290	218	193	116	58	52
2-Chlorophenol	9,877	494	3,457	3,951	0	0	0	751	514	474
Dibromomethane	18,097	2,715	3,619	3,619	7,691	11,582	11,582	2,307	2,172	2,172
3,3-Dimethoxy benzidine	1,180	236	826	944	0	0	0	94	35	24
2,4-Dinitrophenol	664,540	66,454	166,135	199,362	0	0	0	59,809	49,841	46,518
Ethylene Thiourea	0	0	0	0	0	0	0	0	0	0
Maleic Hydrazide	0	0	0	0	0	0	0	0	0	0
Methanethiol	1,855	93	427	557	705	857	779	176	143	130
p-Nitroaniline	33,156	3,316	10,278	13,263	0	0	0	2,984	2,288	1,989
Phosgeme	0	0	0	0	0	0	0	0	0	0
Phthalic anhydride	1,855	186	186	186	0	0	0	167	167	167
Styrene	0	0	0	0	0	0	0	0	0	0
Toluene Diamine	2,722	272	680	817	0	0	0	245	204	191
Vanadium Pentoxide	411	309	309	309	0	0	0	10	10	10
*Alachlor										
Aldicarb										
Aldrin										
Antu										
Antrazine										
Bromacil										

*Pesticide loadings numbers were not included in this chart due to the proprietary nature of the data.

TABLE 5-1. LOADINGS OF DSS POLLUTANTS TO POTW AND RESULTANT RECEIVING ENVIRONMENTS (Continued)

		LOADINGS TO RECEIVING WATERS			LOADINGS TO AIR			LOADINGS TO SLUDGE		
			Unacclimated Loading			Unacclimated Loading			Unacclimated Loading	
Pollutant	Estimated National Loading (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)	Acclimated Loading (kg/yr)	Median (kg/yr)	Low (kg/yr)
Captan										
Carbofuran										
Chlordane										
Chlorobenzilate										
2,4-D										
2,4-DB										
Diazinon										
Dichlorvos										
Dicofol										
Dinoseb										
Diphenamid										
Disulfoton										
Diuron										
Endrin										
Fenthion										
Ferbam										
Folex										
MCPA										
Methoxychlor										
Mevinphos										
Naled										
Napthalam										
Oxyamyl										
Parathion										
Parathion Methyl										
Phorate										
Pyrethrins										
Sodium Fluoroacetate										
Stirofos										
2,4,5-T										
Toxaphene										
Trifluralin										

Pesticide loading numbers were not included in this chart due to the proprietary nature of the data.

kg/year, 1.4 million kg/year, and 30,500 kg/year to water, air, and sludge, respectively. These National loadings estimates provide a rough yardstick for measuring the significance of DSS pollutants received at POTWs and by the receiving media.

Table 5-2 separates the information provided in Table 5-1 into five pollutant classifications for a median unacclimated system and an acclimated system: metals, volatiles, base neutrals, acids, and pesticides. This table was developed by classifying an individual pollutant and summing the partitioned amounts of all pollutants within a class. The classifications provide a rough estimate of the total amounts of pollutants moving through the various pathways and a method of selecting pollutants of concern from the various receiving media based on total mass. The pesticide loadings used to generate Table 5-2 could not be depicted individually in Table 5-1 because the data are confidential.

The acclimated and unacclimated system scenarios represent the high and low ends of the range of two of the three major removal mechanisms: biodegradation and volatilization. Neither scenario takes into account pollutant losses in the POTW collection systems and through combined sewer overflows and both assume constant sludge partition fractions. These scenarios also do not account for POTWs achieving secondary treatment requirements (30 mg/l BOD and 30 mg/l TSS) using technologies other than conventional activated sludge or for POTWs that are marine discharge facilities or are not meeting secondary treatment requirements. The small amount of metals transferred to the air and biodegraded is attributed to cyanide and mercury.

Given these limitations on the results presented in Table 5-2, the following statements can be made. First, the assumption of constant sludge partition fractions for both acclimated and unacclimated system scenarios is not accurate and, combined with the decreased removal fractions going from acclimated to unacclimated estimates, shows a decrease in the loadings to the sludge when in fact both sludge loadings are equivalent or less than at the unacclimated levels. The difference in these sludge loadings would be attributed to biodegradation under the acclimated system scenario. However, data were not available to adjust the sludge partition fractions so that they

TABLE 5-2. SUMMARY OF POLLUTANT LOADINGS

Pollutant	Total Loadings kg/yr	Air		Water		Sludge		Biodegradation	
		kg/yr	%	kg/yr	%	kg/yr	%	kg/yr	%
Median System Unacclimated									
Metals	6,995,081	43,645	<1	2,828,989	40	4,122,354	59	93	<1
Volatiles	50,825,712	21,464,193	42	6,917,532	14	4,413,348	9	18,030,639	35
Base Neutrals	22,208,302	1,773,054	8	5,251,166	24	3,001,629	14	12,182,453	55
Acids	12,366,825	0	0	1,990,768	16	1,482,436	12	8,893,621	72
Pesticides	56,033	74	1	28,016	50	4,483	8	23,538	42
TOTAL	92,451,953	23,280,966	25	17,016,471	18	13,024,250	14	39,130,344	43
Acclimated System									
Metals	6,955,081	4,365	<1	2,828,989	40	4,122,354	59	39,373	<1
Volatiles	50,825,712	12,113,572	24	2,127,566	4	5,178,548	10	31,406,026	62
Base Neutrals	22,208,302	778,962	4	2,209,147	10	3,440,242	15	15,779,951	71
Acids	12,366,825	0	0	651,568	5	1,672,758	14	10,042,499	81
Pesticides	56,033	4,483	8	5,043	9	12,327	22	34,180	61
TOTAL	92,451,953	12,901,382	14	7,822,313	8	14,426,229	16	57,302,029	62

accurately reflected acclimated system loadings to sludge. Second, the largest shift of loadings from one removal mechanism to another when comparing the unacclimated system loadings to the acclimated system loadings is the 44 percent reduction of volatile organics going to the air and the 74 percent increase in biodegradation of volatile organics. Although this shift is predictable, the magnitude of this shift is questionable, and actual volatile organic emissions to the air are probably somewhere in the range between acclimated and unacclimated system scenarios. Third, due to the change in removal fractions when comparing acclimated and unacclimated system scenarios, the application of volatilization fractions causes acclimated volatilization loadings to be greater than unacclimated volatilization loadings (both median and low) for certain pollutants. This is not accurate; however, data were not available to adjust the unacclimated volatilization fractions in order to correct the unacclimated volatilization loadings.

Of the roughly 9.25 million kilograms of DSS pollutants released, 14 to 25 percent volatilizes to the air, 43 to 62 percent biodegrades, 14 to 16 percent partitions to the sludge, and 8 to 18 percent is discharged to surface water. Figures 5-1 and 5-2 show the distribution of metals and organics across POTWs and illustrate the misleading results that would be produced from an effects analysis that spread the pollutants in Table 5-2 across all POTWs. Metals and organics in the influent to each POTW in the 40 POTW Study were summed and ranked from the lowest to the highest concentration.(1) The figures clearly show that total toxic metals and organics are not distributed evenly across all POTWs. High concentrations of these pollutants are found in a small percentage of POTWs. In all cases, the highest concentrations are related directly to industrial discharge to POTWs. To perform an accurate effects analysis, the distribution of DSS pollutants across all POTWs with site-specific information on each POTW would be necessary.

The lack of effects criteria and data also restricts the effects analysis. Table 5-3 is a summary of the criteria that are available for performing the analysis. As shown, the data are limited primarily to priority

TABLE 5-3. EFFECTS STUDY DATA LIMITATIONS

Category	Summary of Available Data
Available loadings information	Priority pollutants plus nonpriority pollutants for the Organics Industry (Section 3.2)
Available POTW effluent concentrations	Priority pollutants
Available criteria by media:*	
Water	65 priority pollutants
Public drinking water supplies	Subset of 18 priority pollutants plus 4 others
Air	Subset of 4 priority pollutants
Sludge	Subset of 16 chemicals and pathogens**

*See Appendix R for complete listing of available criteria and appropriate references.

**These include 14 compounds for which EP toxicity limits have been set (40 CFR 261.24).

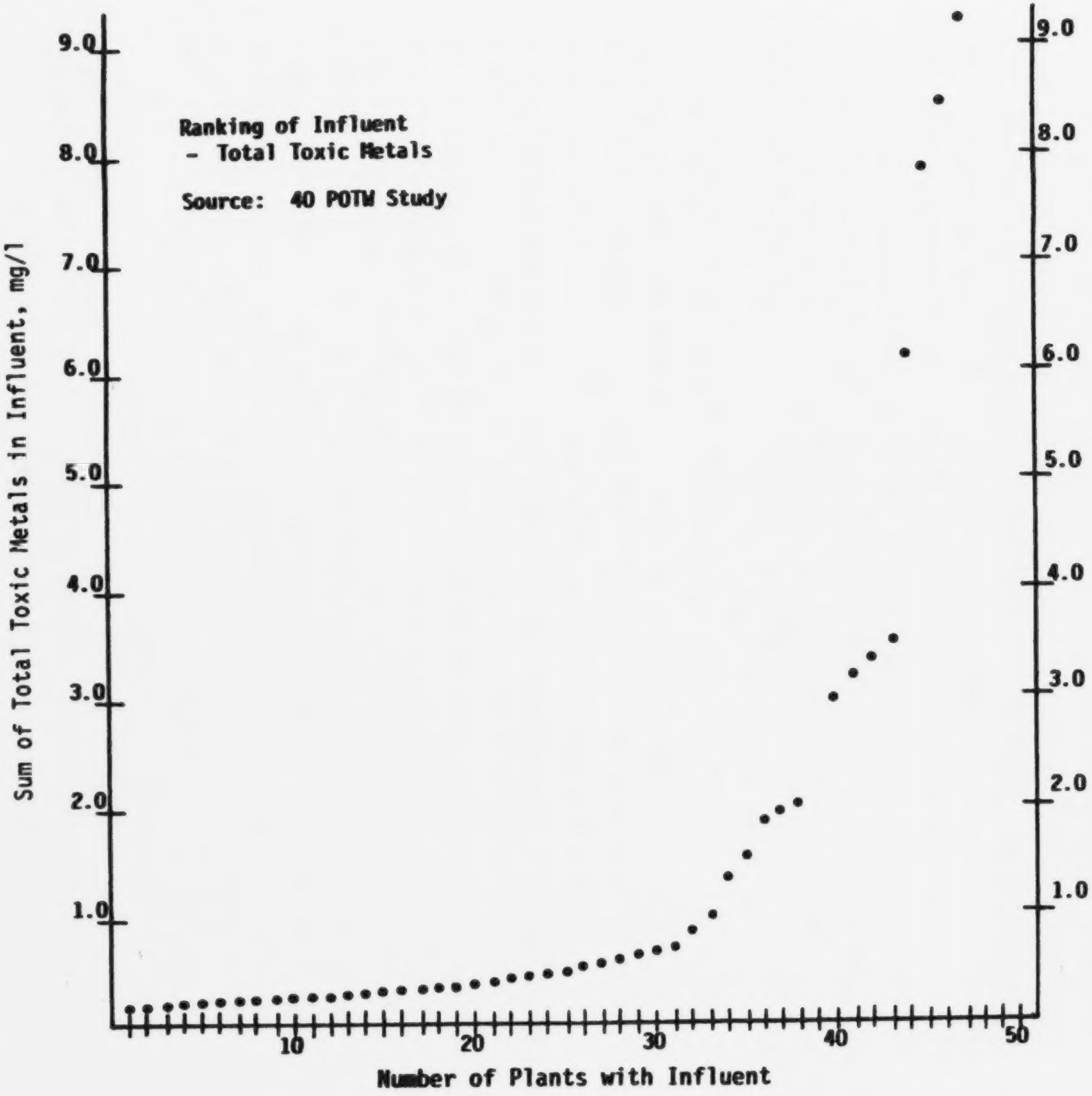
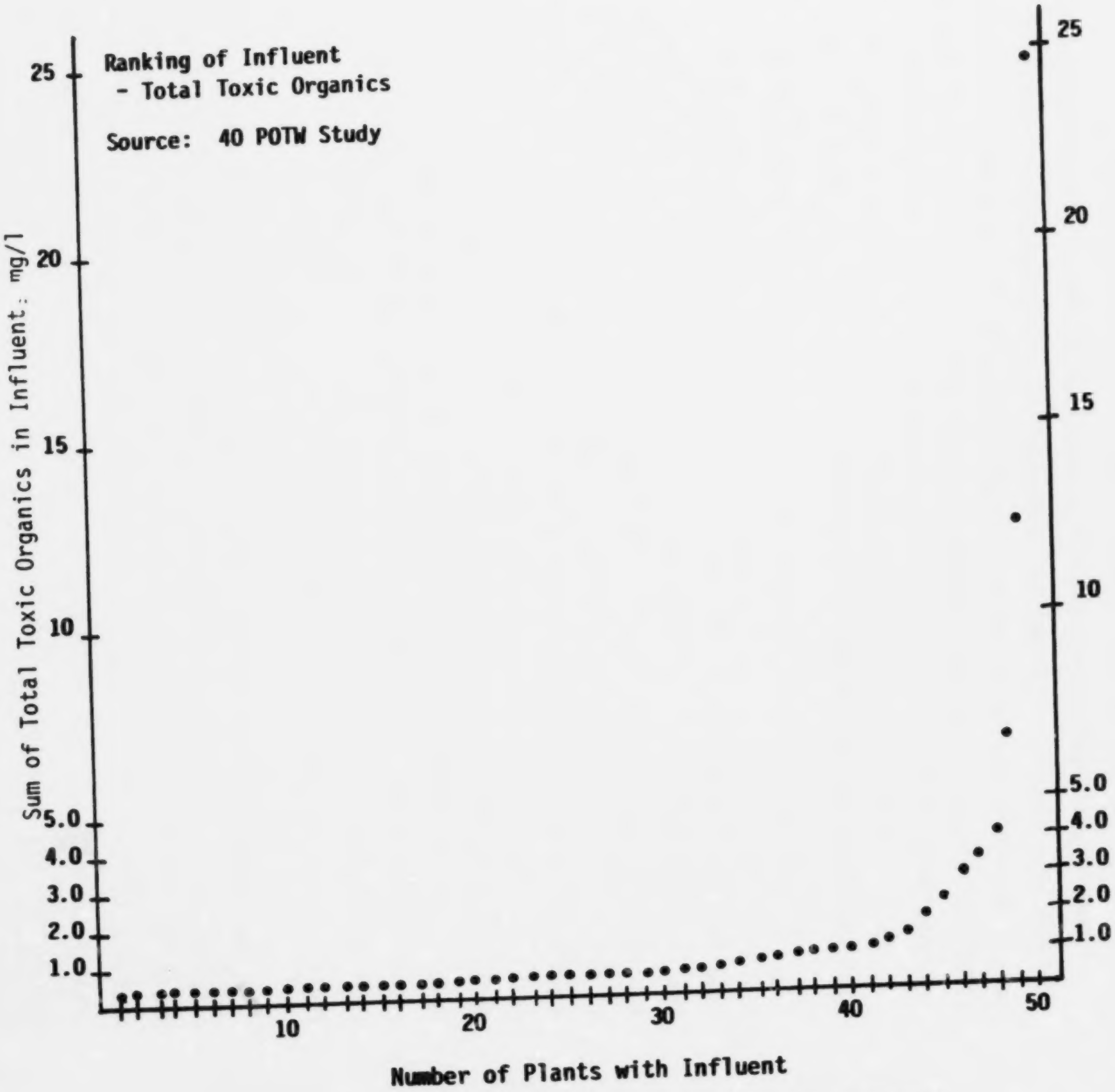


FIGURE 5-1. DISTRIBUTION OF METALS IN POTW INFLUENT



Source: 40 POTW Study

FIGURE 5-2. DISTRIBUTION OF ORGANICS IN POTW INFLUENT

pollutants in surface water. The lack of criteria and data on the distribution of DSS pollutants to POTWs prevents a detailed analysis of the effects on surface water, air, and ground water.

Given these limitations, the following sections provide media-specific analyses of potential environmental effects. Section 5.1 concerns the water media, Section 5.2 concerns the air media, and Section 5.3 concerns the effects of sludge on the land and ground water media. Conclusions are provided in Section 5.4.

5.2 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON SURFACE WATER QUALITY

This section examines the types of effects associated with DSS wastes discharged from POTWs to surface water. Two complementary approaches were used to determine the potential effect of DSE discharges on water quality. The first approach involved comparing instream concentrations of DSS pollutants with applicable criteria (both aquatic and human health) or standards to determine potential impacts on surface water quality. A case study approach also was used, which involved reviewing existing POTW bioassay results. The review indicated that a number of POTWs had toxic discharges. While these results did not address the contribution that DSS discharges might have had on resultant toxicity, the results are indicative of the fact that secondary treatment, even with the imposition of currently promulgated and soon to be promulgated pretreatment controls, may not offer sufficient protection to the aquatic environment in all cases.

The results of this section indicate that a subset of DSS pollutants exceeds water quality criteria even with the imposition of pretreatment standards. These pollutants are not necessarily those that show the largest loadings in Table 5-1. Indeed, this section shows that pollutants with greater toxicity are the pollutants of concern to the water medium, even though they may have lesser loadings than other pollutants. This situation is further demonstrated by using the projected instream concentrations and is supported by the case studies.

5.2.1 Projected Instream Concentrations of DSS Pollutants

Projections of the effects of a discharge on water quality traditionally are based on the comparison of instream wastewater concentrations (IWC) to ambient water quality criteria. To derive IWCs, the dilution ratio (ratio of wastewater discharge flow to receiving stream flow) is calculated and applied to effluent concentration. An exceedance of criteria is indicative of the pollutant's water quality effects, since the criteria were developed to protect human health and the aquatic environment. Two separate calculations are conducted, one for mean flow and one for low flow, with the latter 7Q10 low flow providing the "worst case" scenario. The term 7Q10 refers to the average low flow for 7 consecutive days occurring on the average of once in 10 years.

The value of conducting dilution analyses for this study was limited because of: (1) lack of available effluent or projected effluent concentrations to calculate instream concentrations for all DSS pollutants; and (2) lack of available criteria for DSS pollutants. On the other hand, this analysis also proved valuable in two ways. First, the results acknowledge that POTW treatment will not result in "clean" discharges; that is to say, exceedances do occur. Second, the projection of exceedances may mean that other DSS pollutants with similar characteristics and effluent loadings also may be passing through the treatment system and possibly creating water quality problems.

The analysis involves three separate data bases. The first part of the discussion summarizes the results of a 1983 report titled Addendum to the Assessment of the Impacts of Industrial Discharges on Publicly Owned Treatment Works.(2) This report is important because it describes the ambient improvements that can be expected from implementing the pretreatment program. The Addendum results are particularly valuable since they are derived from wasteload modeling at 1,839 POTWs. The second and third analyses use actual effluent concentrations measured at POTWs. The first of these data bases, the 40 POTW data base, measured a wider range of pollutants, but the data are older than the information in the second data base, which is taken from three separate sources: an AMSA survey(3), a limited survey of POTWs undertaken by Region V(5), and State agencies.(4,6,7)

Addendum Results

The results from the Addendum are based on a modeling exercise that calculated projected POTW effluent concentrations of eight toxic metals, five toxic organics, and cyanide at 1,839 POTWs. The projected concentrations were compared to aquatic water quality criteria and modified on the basis of stream hardness factors (for metals) and consideration of indigenous species. The percent of POTWs exceeding water quality criteria for these pollutants (all but copper and zinc are DSS pollutants) under different treatment scenarios was provided for: (1) raw wasteloads; (2) current treatment technologies; and (3) full compliance with the categorical pretreatment standards for existing sources (PSES).

The last two columns presented in Table 5-4 show the percentage reduction in pollutant exceedances resulting from treatment. Table 5-4 provides results at mean flow and at low (7Q10) flow. It is especially difficult to draw results with respect to the five toxic organics. Because there are few toxic organics exceedances to begin with, figures for percentage exceedances reduction tend to be artificially high or low. The numerical results are considerably more apparent for toxic metals. In absolute terms, the discharge of the DSS pollutants cadmium, silver, lead, and cyanide resulted in the greatest number of exceedances. Implementation of categorical pretreatment standards produced large reductions in percentage exceedances for chromium and nickel, lesser but significant reductions for copper, mercury, and cyanide, and insignificant reductions for lead, silver, and cadmium. These results were consistent for all nonorganic toxic pollutants with the exception of zinc. The highest percentages of reductions were for metals with the lowest number of initial exceedances. These observations refer to the eighth column of Table 5-4, which reflects percentage exceedances reductions in moving from current pretreatment to full compliance with PSES.

Table 5-4 also presents predictions of POTW water quality exceedances when POTW effluent is diluted by 7Q10 low flows rather than average annual flows. Not surprisingly, the number of POTWs and the percentage of all POTWs exceeding the modified water quality criteria increase significantly. On the other hand, Table 5-4 indicates that implementation of full pretreatment is

TABLE 5-4. MODEL INDICATORS OF WATER QUALITY EXCEEDANCES USING MODIFIED CRITERIA AT 1,839 POTWs

A. POTWs EXCEEDING AQUATIC LIFE WATER QUALITY CRITERIA AT MEAN FLOW

	Raw No. of Exceedances	% POTWs	Current No. of Exceedances	% POTWs	Full PSES No. of Exceedances	% POTWs	Raw to Full	Current to Full
Silver	873	47	870	47	862	47	1	1
Benzene	2	0	1	0	0	0	100	100
Toluene	1	0	1	0	1	0	0	0
Cadmium	1,221	66	1,197	65	1,161	63	5	3
Chromium	193	10	121	6	18	1	91	85
Copper	663	36	602	33	528	29	20	12
Mercury	209	11	183	10	152	8	27	17
Nickel	134	7	67	4	10	.5	92	85
Lead	729	40	643	35	618	34	15	4
Phenol	0	0	0	0	0	0	0	0
1,1,1-Trichloroethane	0	0	0	0	0	0	0	0
Bis (2 EH) Phthalate	0	0	0	0	0	0	0	0
Zinc	228	12	151	8	75	4	67	50
Cyanide	589	32	546	30	454	25	23	17

B. POTWS EXCEEDING AQUATIC LIFE WATER QUALITY CRITERIA AT LOW FLOW

	Raw No. of Exceedances	% POTWs	Current No. of Exceedances	% POTWs	Full PSES No. of Exceedances	% POTWs	Raw to Full	Current to Full
Silver	1,348	73	1,348	73	1,342	73	1	.4
Benzene	10	1	3	.2	1	0	91	67
Toluene	11	1	8	1	5	.2	62	38
Cadmium	1,558	84	1,549	84	1,534	83	1	1
Chromium	332	17	252	12	72	4	77	71
Copper	1,138	61	1,099	59	1,043	57	8	5
Mercury	558	30	514	28	471	26	15	8
Nickel	234	11	138	6	33	1.8	85	76
Lead	1,230	67	1,184	64	1,164	63	5	2
Phenol	0	0	0	0	0	0	0	0
1,1,1-Trichloroethane	0	0	0	0	0	0	0	0
Bis (2 EH) Phthalate	0	0	0	0	0	0	0	0
Zinc	495	26	421	22	268	14	46	36
Cyanide	1,103	59	1,075	58	1,022	55	6	5

Source: Reference No. 2

somewhat less effective in reducing exceedances when low flows are used to predict exceedances. This analysis suggests that criteria exceedances will continue even after implementation of the categorical standards, although less frequently. Thus, the current technology-based standards cannot, in and of themselves, resolve water quality concerns. Cadmium, silver, lead, and cyanide remain the DSS constituents of concern from this study.

40 POTW Study

Table 5-5 shows the number of human health criteria for ingestion of drinking water and aquatic organisms that were exceeded by discharges of a subset of the DSS pollutants found in municipal effluents from the 40 POTW study. Although the *Addendum* study analyzed exceedances for 14 pollutants, data available from the 40 POTW study allowed for the calculation of exceedances for 51 pollutants. On the other hand, the 40 POTW data are from 1979 and do not reflect subsequent changes in effluent quality due to pretreatment or changes to RCRA. The 40 POTW study was conducted to determine how well properly operated secondary treatment plants removed toxic pollutants.

This study also differs from the *Addendum* analyses because human health criteria were used rather than the aquatic toxicity criteria used in the *Addendum* study. While this difference makes a comparison between results difficult, it also means that a larger number of pollutants could be analyzed. The Agency has adopted a more complete set of priority pollutant criteria for human health (for 51 pollutants), whereas only 22 of 65 priority pollutants have been assigned aquatic toxicity criteria (14 of which were assessed in the *Addendum*).

Table 5-5 shows the pollutants discharged by POTWs that caused criteria exceedances. Twenty-six of the pollutants caused at least one exceedance, with several causing multiple exceedances. For example, chloroform exceeded criteria for 14 of 18 available data points (78 percent) at both mean and low (7Q10) flow. Discharges of cyanide, nickel, and tetrachloroethylene also resulted in a large percentage of exceedances (greater than 60 percent). Other pollutants discharged with a number of exceedances were mercury,

TABLE 5-5. HUMAN HEALTH CRITERIA EXCEEDANCES 40 POTW DATA BASE

	Number of POTWs with Available Dilution Data and Pollutant Detected	Number of Exceedances at Low Flow	Number of Exceedances at Mean Flow
Benzene	18	7	7
Carbon Tetrachloride*	16	1	1
Hexachlorobenzene*	16	0	1
1,2-Dichloroethane*	17	4	4
1,1,1-Trichloroethane	17	1	1
Hexachloroethane	16	0	0
1,1,2-Trichloroethane*	17	2	2
Bis (2-Chloroethyl) Ether	16	0	0
2,4,6-Trichlorophenol*	16	1	1
Chloroform	18	14	14
1,2-Dichlorobenzene*	17	4	4
1,3-Dichlorobenzene*	17	1	1
1,4-Dichlorobenzene*	17	1	1
1,1-Dichloroethane*	17	3	3
2,4-Dichlorophenol	16	0	0
Ethylbenzene*	18	1	0
Hexachlorobutadiene	16	0	0
Nitrobenzene	16	0	0
N-nitrosodimethylamine	16	0	0
Pentachlorophenol*	17	4	0
Phenol	18	0	0
Diethyl Phthalate	17	0	0
Dimethyl Phthalate	18	0	0
Tetrachloroethylene*	18	11	11
Toluene*	18	1	0
Trichloroethylene*	18	6	6
Vinyl Chloride	17	0	0
Aldrin	17	0	0
Dieldrin	16	0	0
Chlordane	16	0	0
DDT	16	0	0
Endrin	16	0	0
Heptachlor*	16	2	2
Lindane*	17	6	6
PCB 1242*	16	1	1
PCB 1254*	16	1	1
PCB 1221	16	0	0
PCB 1232	16	0	0
PCB 1248	16	0	0
PCB 1260	16	0	0
PCB 1016	16	0	0
Toxaphene	16	0	0
Arsenic*	17	2	2
Cadmium	17	6	6
Cyanide	18	15	13
Mercury	17	6	6
Nickel	18	13	13
Selenium*	16	4	3
Silver	18	3	2
Thallium	16	0	0
Chromium	17	2	1

*Pollutants with violations that were not calculated in the "Addendum" study.

Source: Reference No. 2

cadmium, trichloroethylene, and benzene. Neither trichloroethylene nor tetrachloroethylene were considered in the Addendum analysis.

Other pollutants with calculated exceedances that did not appear in the Addendum include: carbon tetrachloride, 1,2-dichloroethane, 1,1,2-trichloroethane, and 2,4,6-trichlorophenol. However, as seen from Table 5-5, most of these pollutants had very few exceedances. Many of the pollutants (22) had no exceedances at all.

AMSA/Region V

The previous analyses demonstrated that exceedances of water quality criteria can be expected even after POTW treatment for a wide range of DSS pollutants. Another analysis was conducted using effluent data available from the AMSA survey and effluent samples taken at selected POTWs by EPA's Region V. The analysis of these data enabled 17 pollutants to be analyzed at up to 15 plants. The exceedance rate was much lower than that projected in the two previous analyses, as shown in Table 5-6.

Criteria exceedance may not be solely of concern to the aquatic environment. An analysis of the proximity of drinking water intakes to pretreatment POTWs showed that of the 529 drinking water treatment facilities that could be identified downstream of pretreatment POTWs, 130, or about 25 percent of this total, were located within 5 miles downstream. Of these, 107 facilities had dilution rates of less than 25 to 1 at low flow. While no analysis of the effectiveness of water supply systems was undertaken for purposes of this study, this analysis does suggest that such systems should screen for these pollutants in their influent and treated supplies.

5.2.2 Summary of Empirical Data

The previous section attempted to project water quality effects of DSE discharges by POTWs. No clear-cut conclusions on water quality effects can be drawn from the analysis, although the projections do suggest that certain pollutants may be of concern either because of toxicity or prevalence in POTW discharges. This section reviews additional case study information to assess the potential effects of DSE discharges by POTWs and, to the extent possible, verify the projected effects from the previous section.

TABLE 5-6. HUMAN HEALTH CRITERIA EXCEEDANCES BASED ON AMSA AND REGION V DATA

Pollutant	Number of POTWs With Available Dilution Data and Pollutant Detected	Number of Exceedances at Low Flow	Number of Exceedances at Mean Flow
Barium	1	1	1
Cadmium	14	0	0
Mercury	11	5	1
Selenium	4	0	0
Silver	8	0	0
Ethyl Benzene	5	0	0
Nickel	15	4	2
Cyanide	5	0	0
Benzene	2	0	0
Chloroform	7	3	1
1,2-Dichloroethane	1	1	0
Phenol	10	0	0
Tetrachloroethylene	6	3	1
Carbon Tetrachloride	3	0	0
Toluene	7	0	0
1,1,1-Trichloroethane	5	0	0
Pentachlorophenol	2	0	0

Source: Reference Nos. 3 and 5

Bioassay data from three sources are included in this discussion: EPA Region V(5), North Carolina Department of Natural Resources and Community Development(6), and the State of Florida.(7) These sources represent only a small portion of all bioassay work on NPDES permitted effluents. Currently, 39 States are using bioassays to test municipal and/or industrial effluents, and the Agency is pursuing its biomonitoring program (see Tables 5-7 and 5-8).

The data verify that municipal effluents can be very toxic and/or mutagenic. The State of North Carolina found that 32 percent of the POTWs it tested had effluents with some degree of acute toxicity. As a result of these findings, POTWs, the State undertook indepth toxicological analyses of selected municipal discharge characteristics. It reviewed the POTWs' pretreatment programs to determine significant industrial contributors, sampled at various points in the system (i.e., influent, effluent, upstream, and downstream), surveyed the fauna in the receiving stream, and performed 96-hour flow-through acute toxicity tests on the effluent.

Table 5-7 summarizes the results of North Carolina's studies. Most of the POTWs had industrial user communities that were dominated by textile plants. These textile plants discharged biocides [namely 5-chloro(2-2,4-dichlorophenoxy) phenol, tributyl tin hydride, nonyl phenol, and other phenols], which are used as fabric scouring agents, surfactants, deodorizers, and dye levelers.

The impacts of these compounds on receiving streams were sometimes substantial. For example, at one POTW a fish survey of the upstream and downstream segments of the river revealed a significant discrepancy in numbers. In the first 50 meters of the upstream segment, 23 fish of 3 species were found. In the downstream 50 meter section, no fish were found. Similar instances of severe downstream degradation resulting from POTW discharges were documented. These effects generally included lack of species diversity or predominance of pollutant-tolerant species (e.g., sludge worms).

TABLE 5-7. SUMMARY OF INDEPTH NORTH CAROLINA POTW TOXICITY EXAMINATIONS

Name	Treatment Type	LC50s Influent	LC50s Effluent	Percent Industrial Flow	Predominant Industries	Detected Organic Pollutants
Star	Trickling filter	17.5%	60% 14.5% (10% for 96 hr flow through)	70%	Textiles	Phenols Formaldehyde Phenol ethoxylates
High Point (Westside)	Trickling filter	--	17% 30% 43% (64% for 96 hr flow through)	--	--	Phenols Dibutyl phthalate Ethyl hexanoic acid Cholestenediol Cholestadiene Tributyl tin hydride Formaldehyde 10 unidentified organic peaks
Newton Clark Creek WWTP	Clarifiers, lime addition, activated sludge	--	P 25* Note: chronic bioassay showed significant depression in reproductive success	12.5%	Textiles	Tributyl tin hydride Ethyl methyl benzene Trimethyl benzene Diethyl benzene Trichlorobenzene Methyl propyl benzene Petroleum oil 11 unidentified organic peaks
High Point (Eastside)	Trickling filter		26% 50% 21% (100% for 96 hr flow through)	--	--	Phenols
Burlington	Activated sludge with carbon		20% None None (42% for 96 hr flow through)	40%	Textiles	Phenols

*P = percent mortality at highest concentration.

TABLE 5-7. SUMMARY OF INDEPTH NORTH CAROLINA POTW TOXICITY EXAMINATIONS (Continued)

Name	Treatment Type	LC50s		Percent Industrial Flow	Predominant Industries	Detected Organic Pollutants
		Influent	Effluent			
Asheboro	Trickling filter		40% 35% (20% for 96 hr flow through)	33%	Textiles Batteries	Phenols
Burlington Eastside	Activated sludge		39% 50% (15% for 96 hr flow through)			Phenols Tributyl tin hydride 5-Chloro-2-(2,4-dichlorophenoxy) phenol chlorine 3 unidentified organic peaks
Rockwell Southside	Trickling filter		28% 55% (37% for 96 hr flow through)			Tributyl tin hydride Dimethyl pentene Pentacosane Octamethyl - Cyclotetrasiloxane Formaldehyde Phenols 2 unidentified organic peaks
Mt. Airy	Trickling filter		46% P 35* 28% (16% for 96 hr flow through)	80%	Textiles	Nonylphenol Tributyl tin hydride

*P = percent mortality at highest concentration.

Similar results were obtained from the EPA Region V bioassay tests. According to the Region's acute toxicity tests, 53 percent of those plants sampled had effluents that were acutely toxic to some degree. Furthermore, 18 percent of the POTWs tested had effluents that exhibited LC50s when diluted to less than 50 percent.

The State of Florida is conducting a bioassay screening program of municipal and industrial discharges. Bioassay results from that program show that DSS pollutants, including the pesticides lindane and methoxychlor, are of concern as toxic agents in municipal discharges. Other DSS pollutants that were detected were mercury, cadmium, chromium, and lead. All of these pollutants, with the exception of methoxychlor, which was not considered, were found to have criteria exceedances in the previous section. Table 5-8 illustrates these results. Reading from the dechlorinated effluent column, it is apparent that some of the effluents were very toxic. For example, the Sebring plant's effluent had a LC50 toxicity of 12 percent. On the other hand, Vero Beach's plant did not exhibit toxicity after chlorination.

These three separate bioassay studies demonstrate that POTWs, especially those with a substantial percentage of industrial influent, can have a deleterious effect on the environment. The studies also seem to point toward the same pollutants as those that appeared in the dilution analyses as being responsible for toxicity.

5.2.3 Conclusions

In the introduction to this chapter, projected loadings to different media were estimated. Those projections showed 17 million kilograms of hazardous constituents per year making their way to surface waters from unacclimated systems. Ten pollutants contributed a total of 10.2 million kilograms per year in unacclimated and 5.3 million kilograms in acclimated systems, or roughly 60.2 to 67.4 percent of the total being discharged to surface waters. These pollutants were acetone, nickel, formaldehyde, chromium, cyanide, phenol, lead, furfural, xylene, and methylene chloride.

TABLE 5-8. 1982-1984 FLORIDA BIOASSAY RESULTS - LC50 (48 hr)

Facility Name	NPDES #	Effluent Prechlorinated	Chlorinated	Dechlorinated	Comments
Jacksonville Beach STP	FL0020231	40%	43.6%	63.1%	Test organism was M. bahia (toxicity attributed to "lindane and to other chemical constituents")
Marianna STP	FL0020117	D. pulex 54.2%	D. pulex 29.0% S. serrulatus = 9.6%	NT	Test organism was M. bahia (toxicity attributed to "lindane and other chemical constituents") *24 hr test
Daytona Beach Regional and Bethune Point STPs	FL0025984	75.2%	70.3%	46.4%	Test organism was M. bahia (toxicity attributed to "lindane and other chemical constituents")
Fortenberry STP	FL0026816	18%	21%	21%	Test organism was M. bahia (toxicity attributed to "lindane and malathion and other chemical constituents")
Fort Lauderdale "B" STP	FL0020524	78.8%	9.0%	78.6%	Test organism was M. bahia (toxicity attributed to "lindane and other metal constituents")
St. Cloud STP	FL0028959	78%	<5.6%	10% S. serrulatus = 19.8%	Test organism was M. bahia (toxicity attributed to "lindane and other metal constituents")
Fortenberry WWTP	FL0026816	24.3%	22.2%	19.0%	Test organism was M. bahia (toxicity attributed to lindane and mercury)
Fortenberry WWTP	FL0026816	31.2%	32%	32%	Test organism was M. bahia. Tests were performed to determine if alum treatment reduced toxicity. It was found to have only reduced it from 28.8% to 31.2%.
Sebring Airport STP	FL0021288	--	<5.6%	12%	Test organism was D. pulex (toxicity attributed to cadmium, chromium, lead, silver, zinc, and chlorine)
Kanapaha WWTP	FL0032379	96.2%	1.9%	NT	Test organism was D. pulex (toxicity was attributed to mercury, zinc, several unidentified organics, and chlorine)
St. Cloud STP	FL0028959	40.2%	<5.6%	55.3%	Test organism was D. pulex (toxicity was attributed to lindane, methoxychlor, several unidentified organics, copper, mercury, zinc, silver, and chlorine)
Sanford STP	FL0020141	NT	7.2%	78.7%	Test organism was D. pulex
Vero Beach STP	FL0021661	28.7%	NT	NT	Test organism was M. bahia

Note: NT = Not Toxic

Of these pollutants, cyanide, chromium, and lead experienced criteria exceedances in the dilution analyses. Water quality criteria were not available for furfural and formaldehyde. Consequently, criteria exceedance projections could not be made. The analyses for the other pollutants did not result in exceedances.

On the other hand, pollutants that had smaller loadings, but a more significant number of exceedances, were: silver, tetrachloroethane, trichloroethylene, tetrachloroethylene, chloroform, and lindane (lindane is not a DSS pollutant, but was selected as representative of DSS pesticides). Total unacclimated loadings for these compounds (except for lindane) were calculated at roughly 1.9 million kg/year. Among these pollutants, the mean loading was just over 243,461 kg/year, with chloroform being the most prevalent (381,000 kg/yr) and 1,1,1,2-tetrachloroethane the least prevalent (868 kg/yr). The relatively low level of loadings contributed by these pollutants is in contrast to the toxic effects they produce, as measured by the criteria exceedances they caused. Seven of these pollutants have been assigned a CERCLA reportable quantity of one, representing a high level of toxicity. Although chloroform is the least toxic, with a reportable quantity of 5,000, it also is the most prevalent among these pollutants.

The bioassay case studies conducted by the States of North Carolina and Florida found that some pollutants were often the cause of toxicity in municipal effluents. Among those named by the States as toxic agents were phenol, formaldehyde, lindane, silver, lead, and cadmium. Thus, the bioassay results appear to confirm the criteria exceedance projections.

These results suggest that certain DSS pollutants do pass through POTW treatment systems and are of concern to the surface water receiving environment. Other DSS pollutants, including those for which exceedances could not be projected due either to a lack of criteria or available effluent data, are also potentially of concern. Beyond the formulation of the National loading projections for a subset of these DSS pollutants, little information exists on potential effects.

5.3 ASSESSMENT OF EFFECTS OF AIR RELEASES

Air emissions from POTWs emanate from the treatment system and sludge incinerators, as follows:

- Volatilization of organic compounds contained in the discharge. Organic compounds may volatilize enroute to the POTW and at the POTW itself. These pollutants are emitted as gases to both the ambient air and the workplace (POTW) environment.
- Incineration of sewage sludge with discharge constituents that have adsorbed to sludge. Constituents are emitted to the ambient air during sludge incineration. The emissions of concern include particulates, chemicals that adsorb to those particulates, and aerosols formed from the incomplete combustion of the hydrocarbons.

These emissions affect worker health and safety and ambient air quality.

Worker health and safety concerns arise from: (1) increased potential for explosions from volatile constituents in the wastestream; and (2) acute and chronic health effects from contact with volatilized pollutants. The risk of explosions at a POTW was discussed in Chapter 4; it is discussed here only as it relates to actual incidences and their impact on worker health and safety. Acute health effects occur from exposure to a pollutant over a short time period. These effects include neurotoxicity, dermatological problems, and respiratory difficulties. Chronic health effects result from long-term exposure to pollutants at comparatively low concentrations. Carcinogenicity, mutagenicity, and teratogenicity, or their potential, are the most common measures of chronic effects.

Emissions also lead to the degradation of ambient air quality, which can cause both environmental damage and acute and chronic human health effects. These impacts are caused by increases in total suspended particulates (TSP) in the atmosphere, increases in ambient concentrations of ozone due to the photochemical oxidation of hydrocarbons emitted to the ambient air, and human exposure to specific compounds.

Meteorological conditions can have a significant effect on conditions at POTWs that potentially could affect both worker health and safety and ambient air quality. During the winter months, many POTW systems are enclosed, reducing the ventilation of volatilized organics and thereby increasing both the chance and severity of exposure to workers. In contrast, ambient air impacts increase on warmer, sunny days when photo-oxidation (ozone production) occurs more readily than at other times. Hazardous waste dumps or spills also may expose workers to hazardous air emissions. The POTW incidents files and AMSA survey results show that many discharges of organic chemicals occur as illegal dumps and spills. Since POTW workers are not notified of these discharges, they are vulnerable to the resulting toxic air emissions.

The effect of the incineration of contaminated municipal sludges on air quality was not determined in this study because of a lack of adequate information. However, emissions of metals from some sludge incinerators may create localized problems. EPA is considering regulation of sewage sludge incinerators for emissions of chromium, cadmium, and inorganic arsenic. Chromium and cadmium are both candidates for listing as hazardous air pollutants under Section 112 of the Clean Air Act, and arsenic already is listed. Preliminary data suggest that most of the chromium emitted from sewage sludge incinerators is not hexavalent, which reduces concern about this source (the only strong health evidence regarding risk of chromium exposure applies to hexavalent chromium). Sewage sludge incinerators are regulated under Section 112 for emissions of beryllium and mercury. EPA is also reviewing the New Source Performance Standard (NSPS) for sewage sludge incinerators. Currently, EPA plans to require monitoring that will improve proper operation and maintenance of these incinerators.

5.3.1 Description of Air Emissions from POTWs

Chapter 4 provided an indepth discussion of the processes that control the fate of each pollutant in the POTW system. Henry's Law Constant, generally reported in units of atm-m^3/mole, expresses the equilibrium distribution of the compound between air and water, indicating the relative ease with which the compound may be removed from aqueous solution. Chemicals with relatively high vapor pressures and low solubility, such as chloroform, are more likely to vaporize and become airborne than chemicals with low vapor pressures, high solubility, or a high affinity for adsorption to solids and sediment, such as phenol.

In this study, readily volatilized compounds have been defined as those having Henry's Law Constants $>10^{-3}$ atm-m^3/mole. Those pollutants with Henry's Law Constants down to 10^{-5} are considered to be partially volatilized in the POTW system and are treated as such in the quantitative analysis of POTW emissions. In this assessment, only those compounds in the influent that have been calculated to be volatile will be used to determine air effects.

Table 5-9 depicts the major pollutant emissions to air through volatilization at the POTW. Ten pollutants are estimated to account for greater than 90 percent of the total volatile emissions from the POTW. In particular, 1,1,1-trichloroethane and methylene chloride are the most significant emissions to the ambient air in terms of mass.

EPA is considering regulation of 41 highly volatile substances under Section 112 of the CAA. These compounds commonly are found in aqueous wastestreams and readily volatilize. Those compounds facing immediate decision for listing as hazardous air pollutants are depicted in Table 5-10. This list includes all of the compounds identified by the DSS as being of concern due to volatilization from the POTW, with the exception of tetrahydrofuran. For the chemicals presented in Table 5-9, EPA has issued notices of intent to list for methylene chloride, tetrachloroethylene, trichloroethylene, and chloroform. Based on national emission estimates for these compounds prepared by EPA's Air Office, POTWs appear to contribute from about one to nine percent (depending on the pollutant) of total emissions from identified sources (see 50 FR 39626, 52422, and 52880). EPA's Office of Air Quality Planning and Standards is assessing POTWs as a source emitting these compounds.

In a second study of emission releases from a wastewater treatment plant, of the nine compounds studied, GCA found that benzene, toluene, and 1-2,dichloroethane were the most significant compounds released to air.(8) This compares favorably with the National loadings fate data in Chapter 4, which also showed that toluene and benzene are significant contributors to total air emissions. While Chapter 4 indicates 1,2-dichloroethane is released primarily to air, the National loadings for this compound are so small that it

TABLE 5-9. MAJOR POLLUTANT EMISSIONS TO AIR BY POTW VOLATILIZATION

	Emission (Kg/yr)		
		Unacclimated	
Pollutant	Acclimated	Median	Low
1,1,1-Trichloroethane*	2,989,002	3,185,647	3,008,667
Methylene Chloride*	2,087,837	2,868,029	2,802,097
Xylenes*	1,641,683	4,810,996	4,700,398
Chloroform*	1,199,614	1,370,987	1,370,987
Trichloroethylene*	1,149,702	1,203,297	1,175,635
Toluene*	895,126	2,713,645	2,713,645
Tetrachloroethylene*	679,341	1,026,559	996,173
Ethyl Benzene*	518,499	1,571,871	1,571,871
Tetrahydrofuran	496,738	915,043	854,041
Benzene*	442,533	1,341,572	1,341,572

*Pollutants considered for regulation under the CAA.

TABLE 5-10. SUBSTANCES UNDER CONSIDERATION FOR LISTING UNDER SECTION 112 OF THE CLEAN AIR ACT

Already Listed Under 112

Asbestos
Beryllium
Mercury
Vinyl Chloride
Benzene
Radionuclides
Inorganic Arsenic
Coke oven emissions

Decisions Not to List or Notices of Intent Not to List

Manganese
Nickel
Polycyclic organic matter
Acrylonitrile
Toluene
Methyl Chloroform (1,1,1-Trichloroethane)
Vinylidene Chloride (1,1-Dichloroethylene)
Epichlorohydrin
Hexachlorocyclopentadiene (HCCPD)
Chlorobenzenes
Chloroprene
Phenol
1,1,1-trichlorotrifluoroethane (Freon 113)

Notices of Intent to List

Cadmium
Chromium
Carbon Tetrachloride
1,3-Butadiene
Methylene Chloride (Dichloromethane)*
Perchloroethylene (Tetrachloroethylene)
Trichloroethylene
Ethylene Dichloride (1,2-Dichloroethane)
Chloroform
Ethylene Oxide
Dioxin

*Methylene chloride was addressed in a Federal Register notice announcing EPA's plans to regulate under Section 4(f) of the Toxic Substances Control Act. Perchloroethylene is also a candidate for 4(f) regulation.

is not a significant contributor in this analysis. However, the Philadelphia study (discussed later in this section) found that 1,2-dichloroethane was emitted in significant amounts from the wastewater treatment plant and that benzene also was emitted in somewhat smaller amounts.(9) The major sources of these pollutants are discharging to a small number of POTWs. For example, there are approximately 15,000 wastewater treatment plants, but there are only 468 organic chemical industry plants discharging process wastewaters to POTWs.

5.3.2 Assessment of Effects

Because of time and budget constraints, a precise analysis of the quantitative effects of air emissions due to DSE discharges was not possible without POTW-specific data, such as that collected in the Philadelphia study. In lieu of such information, qualitative analyses of potential effects were completed using pollutant incident reports and case studies. The potential effects to worker health and safety are:

- Risk of explosion
- Acute health risk
- Chronic health risk (other than cancer)
- Chronic cancer risk.

Chapter 4 discussed those DSE compounds that pose a significant risk of explosion. Table 5-11 lists 10 adverse health and safety episodes at POTWs; this list also demonstrates that explosions can occur at POTWs as a result of influents received.(3) Pollutant incident reports from 10 POTWs reflect occurrences of occupational health hazards in the collection and/or treatment systems. No industrial hygiene samples of airborne concentrations were collected when these occurrences took place. It is presumed that the concentrations exceeded the OSHA-specified permissible exposure limit or American Council of Government and Industrial Hygienists-specified threshold limit values. Appendix S lists the PELs and TLVs for each of the DSS pollutants. Table 5-11 identifies the cities, pollutants, and worker health effects associated with these incidents. The health-related effects of these incidents range from the loss of one or more workers for part of a day to several days, to one documented fatality.

TABLE 5-11. DOCUMENTATION OF OCCUPATIONAL HEALTH HAZARDS IN POTW COLLECTION AND TREATMENT SYSTEMS

POTW	POLLUTANT	WORKER EFFECTS
Baltimore, MD	Benzene, toluene, other solvents	Nausea
Gloucester County, NJ	1,1,1-Trichloroethane	Fatality by inhalation
Louisville, KY	Hexane	Nausea
Mt. Pleasant, TN	Organics and metals	Nausea
Naugatuck, CT	Chlorine	Fatality
Passaic Valley, NJ	Volatile compound	Shortness of breath, skin irritation
Pennsauken, NJ	Benzene, toluene, phenol, chloroform	Shortness of breath, watery eyes
St. Paul, MN	Solvents	Headaches
South Essex, MA	Hexavalent chromium	Skin irritation
Tampa, FL	Organic solvent	Nausea

The acute and chronic toxic effects of exposure to volatilized pollutants are well-documented in medical and toxicological literature. These effects are presented for the major pollutants that account for most of the total volatile emissions in Table 5-12. The effects of these carcinogenic and mutagenic pollutants range from irritations to skin, eyes, nose, or throat to rapid unconsciousness and death. The acute effects of exposure vary significantly based on the concentration to which workers are exposed.

While it is impossible to quantify the exposure levels at which workers suffered effects from the incidents shown in Table 5-11, it is presumed that the levels exceeded the OSHA and ACGIH limits. It is likely that workers exposed to pollutants (which could not always be specifically identified) may not have recognized any danger; for example, the odor threshold for benzene (which was positively identified in two incidents) is 12 ppm, while the OSHA and ACGIH limits are both 10 ppm. Thus, POTW workers probably were exposed to exceedances of the OSHA and ACGIH values before they detected the relatively pleasant odor characteristic of benzene.

Ambient Air Quality

The CAA directs EPA to develop ambient air quality standards for certain pollutants to protect public health and welfare. Operations at POTWs may contribute to ambient concentrations of two of these pollutants: ozone and particulate matter. The potential effects of POTW emissions on air quality with regard to these pollutants are discussed below.

Many air pollutants are of health concerns for reasons other than their contribution to ambient levels of criteria pollutants, such as ozone and particulate matter. Many individual pollutants cause other health effects, both acute and chronic, at certain levels of exposure. These health effects include cancer, renal and liver toxicity, mutagenicity, teratogenicity, and other health effects. For nonthreshold pollutants such as carcinogens, a risk exists at any level of exposure. For noncarcinogenic pollutants, the highest pollutant concentrations will affect workers in the sewer system and headworks of the treatment plant, with concentrations and associated risks dropping off

TABLE 5-12. TOXICITY OF 16 MAJOR VOLATILE POLLUTANTS

Pollutant	Classification	Exposure Route	OSHA Standard	ACGIH Standard	Chronic Effects	Acute Effects
1,1,1-Trichloroethane	Carcinogen	Breathing and through the skin	350 ppm	350 ppm	Liver and adrenal gland cancer in animals; thickening and cracking of the skin.	Lightheadedness; irregular heart beat; irritation of the eyes, nose, mouth, and throat; unconsciousness or death.
Methylene Chloride	Mutagen	Breathing and through the skin	500 ppm	100 ppm	Genetic changes in living cells; lung irritation; liver damage; thickening and cracking of the skin.	Severe skin burns; eye irritant; fluid in the lungs; fatigue and shortness of breath; rapid unconsciousness and death.
Trichloroethylene	Carcinogen	Breathing	100 ppm	50 ppm	Liver cancer in animals; skin irritation; liver and kidney damage; memory loss, headache, and depression.	Irritation of the eyes, nose, throat, and lungs; fatigue, dizziness, visual disturbances, loss of muscle control, mental confusion, and nausea.
Chloroform	Carcinogen	Breathing and through the skin	50 ppm	10 ppm	Cancer of the liver, kidneys, and thyroid in animals; drying and cracking of the skin.	Nose, throat, and skin irritant; dizziness.
Xylenes	------	Breathing and through the skin	100 ppm	100 ppm	Drying and cracking of the skin.	Dizziness, excitement, drowsiness, and uncoordination; eye, nose, and throat irritant; nausea, vomiting, and abdominal pain.
Toluene	-----	Breathing and through the skin	200 ppm	100 ppm	Liver and kidney damage.	Fatigue, headache, confusion, and dizziness.
Tetrachloroethylene	Carcinogen	Breathing and through the skin	100 ppm	50 ppm	Liver cancer in animals; drying and cracking of the skin.	Liver and kidney damage; lung, eye, nose, mouth, and throat irritant.

TABLE 5-12. TOXICITY OF 16 MAJOR VOLATILE POLLUTANTS (Continued)

Pollutant	Classification	Exposure Route	OSHA Standard	ACGIH Standard	Chronic Effects	Acute Effects
Methanol	-----	Breathing and through the skin	200 ppm	200 ppm	Liver damage; drying and cracking of the skin.	Eye, nose, throat, and mouth irritant; permanent blindness; headaches, dizziness, and nausea; death
Ethyl Benzene	-----	Breathing	100 ppm	100 ppm	Liver and kidney damage.	Irritation of the eyes, nose, and throat; loss of muscle control; lung irritation.
Tetrahydrofuran	-----	Breathing and through the skin	200 ppm	200 ppm	-----	Headaches; respiratory discomfort or failure.
Benzene	Carcinogen	Breathing and through the skin	10 ppm	10 ppm	Leukemia; menstrual disorders; damage to blood-forming organs.	Dizziness and headaches; convulsions and coma; irritation of the eyes, nose, and throat.
Formaldehyde	Carcinogen	Breathing and through the skin	3 ppm	2 ppm	Nose cancer in animals; skin allergy; asthma-like allergies; bronchitis.	Skin irritation and burns; irritation of the nose, mouth, and throat; fluid in the lungs; spasm of the airway.
Furfural	-----	Breathing and through the skin	5 ppm	2 ppm	Skin allergy; numbness of the tongue; liver damage.	Skin irritation; shortness of breath; unconsciousness and death.
Chlorobenzene	-----	Breathing and through the skin	75 ppm	75 ppm	Liver, lung, and kidney damage.	Skin irritation; eye, nose, mouth, and throat irritation; light-headedness.
1,4-Dichlorobenzene	-----	Breathing and through the skin	50 ppm	50 ppm	Nervous system damage; skin allergy; lung, liver, and kidney damage; anemia.	Headaches and dizziness; swelling around the eyes, hands, and feet.
Acetone	-----	Breathing and through the skin	1,000 ppm	750 ppm	Liver and kidney damage; respiratory irritation.	Skin or eye irritation; dizziness.

with increasing distance from the plant. For individual noncarcinogenic pollutants, ambient concentrations outside the plant rarely will approach levels causing threshold health effects. However, POTWs may emit chemical mixtures consisting of several compounds with similar health effects. If the cumulative health effects of these compounds are assessed, the combined exposures may exceed threshold levels. Exposures to complex mixtures probably will be most significant in areas where POTWs receive large amounts of industrial wastewaters.

VOC Emissions

POTW operations contribute to ozone formation through emissions of volatile organic compounds (VOC). These emissions can occur as an indirect result of POTW treatment processes, and/or incineration of sewage sludge. Of the approximately 1,500 pretreatment POTWs, 173 are located in ozone nonattainment areas. No conclusions can be drawn regarding ozone nonattainment areas and air emissions from POTWs, but one EPA study in Philadelphia identified the city's largest POTW as the largest single source of unregulated VOC emissions (455 kkg/yr) in the city. This study is described in the following section. In drawing comparisons to ozone generation from VOC emissions, there are several VOCs that are nonreactive (will not generate ozone). These nonreactive VOCs are ethane, methane, 1,1,1-trichloroethane, methylene chloride, and chlorinated fluorocarbons (CFCs). EPA also has considered ruling that tetrachloroethylene is nonreactive.

In this analysis, total VOC emissions to the ambient air from POTWs were estimated to range from 13,000 to 23,000 kkg/yr. This compares to the approximately 19.9 million kkg/yr of VOC emissions from all sources nationally (1983). Of this total, POTW emissions represent less than 1/10 of 1 percent. This may be somewhat misleading, however, since no single source category contributes more than a few percentage points to the total. Another way to put VOC emissions from POTWs into perspective is to compare them to total emissions from other VOC source categories.

As indicated earlier, the lack of site-specific data prevented more detailed analysis of possible effects of POTW emissions on actual ozone concentrations in the ambient air. The 35 County Study suggested that a significant portion of the VOC emission total from POTWs may be emitted by a relatively small number of plants, probably no more than a dozen.(10) These plants receive a large amount of industrial wastewater and are probably among the most significant VOC sources in those metropolitan areas where the plants are located. The benefits of controlling VOC emissions and thereby reducing ambient concentrations of ozone include reduction of both human health effects and environmental damage. The health effects associated with ozone exposure include both respiratory (lung function impairment and irritation of the mucous membranes of the nose and throat) and nonrespiratory (eye irritation and headaches) effects. The environmental benefits of reducing ozone concentrations include reductions in damage to crops, forests, and ornamental plants and materials. Reductions in ozone concentrations also improve visibility. EPA has estimated the dollar value of controlling a ton of ozone-producing VOC emissions to be $530, including all of the effects mentioned above.(11) About half of the total benefits come from reductions in agricultural crop damage.

EPA has no regulatory standards affecting VOC air emissions from POTWs. As mentioned earlier, EPA is considering listing several compounds that are emitted from POTW operations. Methylene chloride, tetrachloroethylene, trichloroethylene, 1,2-dichloroethane, and chloroform are each candidates for listing as hazardous air pollutants under Section 112 of the CAA. In addition, methylene chloride and tetrachloroethylene are candidates for regulation under Section 4(f) of the Toxic Substances Control Act.

In preparing for decisions on these compounds, EPA has developed preliminary quantitative risk estimates for lifetime exposure to some of these compounds. The following numbers represent plausible upper bounds of cancer risk after a lifetime (70 years) of exposure. The unit risk factors were obtained from the Carcinogen Assessment Group. The incidence estimates are an aggregate estimate of the annual number of cases that might be expected. These estimates were obtained by multiplying the lifetime risk estimates by the number of people exposed and then dividing by 70 years.

Compound	Maximum Individual Lifetime Risk	Annual Incidence Estimate
Chloroform	2.0×10^{-6}	0.46
Tetrachloroethylene	1.3×10^{-6}	0.03
Trichloroethylene	1.1×10^{-5}	0.09
1,2-Dichloroethane	5.0×10^{-4}	2.7

The Philadelphia Study

EPA has conducted multimedia environmental analyses in several metropolitan areas, notably Philadelphia, and that work has included assessments of air emissions from POTWs. In developing the data base for the Philadelphia study, the Philadelphia Water Department provided information on industrial discharges to the city's Northeast Wastewater Treatment plant. This plant received large discharges (over a ton a day) of volatile organics from a single industrial facility. The onsite ambient air monitoring program was conducted at one site upwind of the aeration basins and two sites downwind. The results are summarized in Table 5-13. The differences between upwind and downwind concentrations are striking, particularly for 1,2-dichloropropane and 1,2-dichloroethane.

A longer-term ambient monitoring program also was conducted in Philadelphia. Ten monitoring sites were chosen, and samples were collected every third day over a 90-day period. Earlier estimates of emissions from volatilization at the POTW were made using mass balance calculations. These emission estimates then were used in a dispersion model to estimate ambient concentrations. In comparing observed to predicted concentrations, most ambient measurements were higher than the predicted concentrations. The difference appears to be due to incomplete assessment of some emission sources and volatilization from sewer line wastewaters enroute to the POTW.

The study focused on methylene chloride, 1,2-dichloroethane, 1,2-dichloropropane, chloroform, carbon tetrachloride, trichloroethylene, tetrachloroethylene, and benzene. The study's final emission estimates were highest for 1,2-dichloropropane, 1,2-dichloroethane, and tetrachloroethylene with 221 kkg/yr, 188 kkg/yr, and 41 kkg/yr, respectively. The emissions from

TABLE 5-13. IEMD's AIR MONITORING RESULTS FOR PHILADELPHIA'S NORTH EAST WATER POLLUTION CONTROL PLANT

(ug/m^3)

Compound	Upwind 10/6/83 AM	Downwind 10/6/83 AM Site 1	Downwind 10/6/83 AM Site 2	Upwind 10/6/83 AM	Downwind 10/6/83 AM Site 1	Downwind 10/6/83 AM Site 2	Upwind 10/7/83 AM	Downwind 10/7/83 AM Site 1	Downwind 10/7/83 AM Site 2	Upwind 10/7/83 AM	Downwind 10/7/83 AM Site 1	Downwind 10/7/83 AM Site 2
Methylene Chloride		0.42			0.24	1.30	0.54	1.40	0.95		3.20	0.06
Chloroform							2.70	0.06				
Carbon Tetrachloride	1.70	1.00	1.70	0.77	1.80	1.70	2.00	2.30	2.10	0.95	1.60	1.50
1,2-Dichloropropane	46.40	137.00	54.50	20.40	102.00	36.70		569.90	318.60	0.12	419.20	269.80
1,2-Dichloroethane	ND	6.80	2.60	1.50	8.30	3.30	ND	242.40	135.80	ND	91.40	50.90
Trichloroethylene	2.40	1.80	2.10		4.50	1.70	6.70	21.30	10.70	2.60	7.40	6.80
Tetrachloroethylene	60.70	90.20	13.60	29.60	49.30	69.60	11.80	149.00	69.50	22.90	195.00	61.20
Benzene	9.30	3.10	0.77	5.00	5.40	5.40	12.30	5.40	4.00	8.90	12.90	4.20

HIGHER DOWNWIND VALUES PARTICULARLY CLEAR FOR DCE AND DCP the POTW account for almost 50 percent of 1,2-dichloropropane emissions and 30 percent of 1,2-dichloroethane emissions for the total metropolitan area. The total emission estimate for volatilization of these eight compounds reached 455 kkg/yr. The POTW is probably the largest single source of VOC emissions in the city. These discharges to the Philadelphia POTW have been linked to the organic chemical industry.

EPA also estimated lifetime cancer risks associated with human exposure to these eight compounds. Assuming that cancer risks are simply additive, the cumulative maximum lifetime risk of cancer for the eight pollutants was estimated at 5.6×10^{-5}.(12) Roughly 68 percent of that total is due to exposure to 1,2-dichloropropane at 3.8×10^{-5}, with 1,2-dichloroethane contributing another 21 percent at 1.2×10^{-5}. The other compounds contribute the remaining 11 percent to the total risk.

In the Baltimore study, the maximum lifetime individual risk for benzene emissions from the Patapsco POTW was estimated at 3.3×10^{-4}.(13) This was based only on mass balance calculations and data obtained from EPA on biodegradation of specific compounds. No ambient monitoring was conducted.

Evaluation of air effects is perhaps the most difficult of the effects to assess due to both a lack of applicable criteria and the lack of data on air emissions from POTWs. What has been shown, however, is that large amounts of pollutants are being emitted to the air. In fact, the air receives the highest mass loadings of any of the receiving environments. Actual quantitative analysis supports the National loadings data that POTWs can be a significant VOC source in a metropolitan area. Furthermore, there have been documented effects of adverse impacts to worker health and safety from contact with these volatile constituents. There is a considerable need for further study of effects from air emissions at POTWs.

5.4 EFFECTS ON GROUND WATER

There are six possible pathways for the contamination of ground water by the discharge of hazardous waste constituents to a POTW. These pathways are:

- Exfiltration from sewers
- Leaks from unit processes at the wastewater treatment plant site, including seepage from sludge piles
- Land application of municipal sludge (land filling and land spreading)
- Wastewater treatment lagoons
- Land treatment of municipal wastewater
- Deep well injection.

In 1985, EPA surveyed States to identify the major sources of ground water pollution.(14) This was a qualitative survey based on indications State employees had of their sources. The sources identified, in order of most frequently cited were:

- Leaking underground storage tanks
- Septic tanks
- Surface impoundments
- Agricultural
- Municipal landfills
- Onsite industrial landfills
- Abandoned hazardous waste sites
- Oil and gas brine pits
- Other landfills
- Salt water intrusion
- Injection wells
- Regulated hazardous waste sites
- Highway de-icing
- Land application/treatment.

The survey indicates that POTWs, including treatment tanks and collection systems, are not considered a threat to ground water. On the other hand, they may not be perceived as a problem simply due to a lack of available data. Although not identified in the survey of States, exfiltration from sewers is potentially of concern. In a 1977 Report to Congress(15), the Agency identified municipal wastewater collection, treatment, and disposal practices as a potential source of ground water contamination. The Report cited a few case studies of ground water contamination resulting from such practices, but further reported that while widespread contamination may be suspected, "...the magnitude is unknown." Further, the report focused on contamination from the following constituents: dissolved and suspended solids, biochemical oxygen demand, nitrates, and other commonly controlled pollutants.

Studies have shown that infiltration of ground water to sewers does occur at many POTWs and under different hydrogeologic conditions, exfiltration is possible. The fact that the collection system carries untreated raw wastewater heightens the concern for the possible source. However, the lack of information on the amount of exfiltration as presented in Chapter 4 limits further analysis. Of the sources listed by the States, surface impoundments, municipal landfills, salt water intrusion, injection wells, and land application treatment are categories that could include POTW operations. All of these categories are potential sources of hazardous constituents leaching to ground water.

In response to Section 3018(c) of the HWSA of 1984, an EPA study is underway to determine the impact of municipal wastewater treatment lagoons on ground water. The lagoon study is to be completed by May 1987 and preliminary results were not available for this report.

Land treatment systems include the disposal of treated effluents on land for irrigation and further treatment of the wastewater by the soil. This practice is conducted by just over 1,200 of 15,000 POTWs nationwide. POTWs using this disposal method are required to perform thorough chemical analysis and ground water monitoring. These facilities must comply with regulations published in the Federal Register of February 2, 1976 (Vol. 41, p. 9160; PRM 79-3, November 15, 1978), "Alternative Waste Management Techniques for Land Treatment: Criteria for Best Practicable Waste Treatment Technology," that require disposal practices not to cause exceedances of drinking water criteria at the point where the effluent mixes with the water table. Because of the controls and regulatory scrutiny applied to land treatment systems, these systems are assumed, for the purpose of this study, to produce minimal ground water impacts.

Deep well injection of treated POTW effluents is limited to less than 100 of 15,000 facilities. Again, because of the regulatory scrutiny applied to these facilities, they were assumed to produce minimal ground water impacts.

As a result of the above, this section is limited to a discussion of the pollutants of concern in ground water, mobility of pollutants in soil, and disposal of municipal sludge.

Sludge Disposal

The quantity of toxics in sludge that may enter ground water or the food chain is directly related to the sludge disposal practices of the POTWs and the amount of industrial flow that these POTWs receive. Fifty percent of municipal sewage sludge either is disposed in landfills or is land applied. As was demonstrated in earlier sections, the pretreatment POTWs receive the bulk of the industrial flow. The sludge from these POTWs, therefore, can be expected to contain most of the DSS pollutants. The fate of these substances is highly dependent on the composition of the soil. The mobility of these compounds depend on their reactivity with the soil components. The extent to which they are taken up by plants and soil organisms depends on the individual compound. Their degradability is dependent on their molecular structure, the microbial population present, and climatic factors.

Table 5-14 is a summary of a survey of States' ground water monitoring data.(14) The survey focused on volatile organic constituents, constituents which are also of concern as DSS pollutants. However, as Table 5-2 demonstrates, these pollutants will likely volatilize to air (24 or 43 percent) and biodegrade in the treatment system (35 or 62 percent) if discharged to a POTW. Little of the volatile organics in the influent will end up in the sludge (9 or 10 percent). As mentioned earlier, further studies may show that the amount of volatiles removed to the sludge will be lower. The major concern of volatile discharge to sewers resulting in ground water contamination is the concern that wastewater may leak from pipes prior to reaching the POTW; however, further study is needed before conclusions can be drawn about this effect as a significant ground water contamination source.

TABLE 5-14. SUMMARY OF NATIONWIDE GROUND WATER STATE SUMMARIES OCCURRENCE DATA

(Random sample: n = 466)

Parameter	Quantification[1] limit ug/l	Positives		Median ug/l	Max ug/l
		No.[2]	Percent		
Tetrachloroethylene	0.2	34	7.3	0.5	23
Trichloroethylene	.2	30	6.4	1	78
1,1,1-Trichloroethane	.2	27	5.8	.8	18
1,1-Dichloroethane	.2	18	3.9	5	3.2
1,2-Dichloroethylenes (cis and/or trans)	.2	16	3.4	1.1	2
Carbon Tetrachloride	.2	15	3.2	4	16
1,1-Dichloroethylene	.2	9	1.9	.3	6.3
m-Xylene	.2	8	1.7	.3	1.5
o- + p-Xylene	.2	8	1.7	.3	.9
Toluene	.5	6	1.3	.8	2.9
1,2-Dichloropropane	.2	6	1.3	.9	21
p-Dichlorobenzene	.5	5	1.1	.7	1.3
Ethylbenzene	.5	3	.6	.8	1.1
Benzene	.5	3	.6	3	15
1,2-Dichloroethane	.5	5	.6	.6	1
Vinyl Chloride	1	1	.2	1.1	1.1
1,1,2-Trichloroethane	.2	0			
1,1,1,2-Tetrachloroethane	.2	0			
1,1,2,2-Tetrachloroethane	.5	0			
Chlorobenzene	.5	0			
m-Dichlorobenzene	.5	0			
o-Dichlorobenzene	.5	0			
Styrene	.5	0			

[1] Analytical detection limit

[2] Number of identifications above detection limit

Table 5-2 shows that the major contribution to sludge comes from metals (60 percent). The other pollutant classes provide only a minimal percentage of mass to sludge. The DSS did not address zinc or copper, although these two pollutants are major constituents of municipal wastewater and sludge.

Sludges are regulated by Subtitle D of RCRA (40 CFR Part 257) and Section 405 of CWA. Subtitle D addresses PCBs, cadmium, and pathogens in sludges that are land applied. In response to the Subtitle D regulation, POTWs have been testing their sludge using the RCRA hazardous characteristics test procedures: ignitability, corrosivity, reactivity, and EP toxicity. In particular, the EP toxicity test has been considered most relevant for characterizing sewage sludge. Based on these tests, most sludge has not been shown to be hazardous. In the few cases where sludges were shown to be hazardous, industrial discharge was the reason cited for failing the EP toxicity test.

In response to the need for additional controls over municipal sludge disposal, EPA currently is developing additional regulations pursuant to Section 405 of CWA. Two approaches are being taken: one approach is to develop State regulations for management of sludge disposal programs and the second is to develop technical criteria for disposal of sludge. At this stage in the regulatory development process, EPA has developed indices to prioritize constituents in sludge that might be assessed.(16) These indices were used in the following section to evaluate the DSS pollutants found in sludge.

These indices ranked 50 compounds found in sludge according to certain effects that they might have in each disposal option. These indices were calculated from the typical and worst case sludge concentrations. The calculations of these indices were theoretical and, therefore, provide only a qualitative measure of the effects of these compounds in sludge. The indices considered multiple factors such as toxicity, uptake potential, mobility in soil, and prevalence.

The total industrial pollutant loadings (derived in Chapter 4) to sludge by compound are shown in Table 5-1. The pollutants of greatest amounts in sludge are shown in Table 5-15; they are phenol, chromium, methanol, toluene, xylene, cyanide, bis(2-ethyl hexyl)phthalate, nickel, and formaldehyde. The presence of methanol in sludge is considered an artifact of the methodology used in the DSS. The volume of methanol in the influent is so large that even a small percentage being removed to sludge results in a large loading to the sludge. Methanol in the influent will largely biodegrade or volatilize.

Hazard estimates for the land application of sludge were derived by EPA for toxicity to soil biota, toxicity to predators of soil biota, phytotoxicity, plant uptake, toxicity to animals resulting from plant consumption, toxicity to animals from sludge ingestion, human toxicity from plant consumption, human toxicity from animal ingestion, and incidental soil ingestion by humans. For landfilling, hazard indices were developed for ground water contamination and human toxicity resulting from ground water contamination.

Table 5-16 shows the incremental hazard indices for landfilling of DSS pollutants contained in sludge. These numbers represent the incremental risk values associated with landfilling sewage sludge. These values give a relative comparison of risk among the pollutants for specific environmental pathways. PCBs, arsenic, and organic pesticides and herbicides are a problem when sludge is land-filled, as are some metals. However, more mobile organic compounds, such as benzene and trichloroethylene, also may create a hazard.

Table 5-17 shows the incremental hazard indices associated with the various pathways related to land application of DSS pollutants. These indices illustrate the significance of the bioaccumulation of toxics, particularly organics, in the food chain. PCBs pose the most significant hazard, followed by other organic herbicides and pesticides. Metals, such as cadmium, arsenic, mercury, and nickel, are also a problem, but to a lesser degree.

Of the DSS compounds discharged in large quantities by industry, only metals such as chromium, selenium, and arsenic are problems as indicated by

TABLE 5-15. NATIONAL LOADINGS TO SLUDGE

(kg/yr)

	Acclimated	Unacclimated Median	Unacclimated Low
Phenol	1,533,465	1,372,047	1,291,339
Chromium	1,482,736	1,482,736	1,482,736
Methanol	1,441,726	1,369,630	1,369,630
Toluene	1,002,541	678,411	678,411
Xylenes	985,010	902,062	881,325
Cyanide	820,099	820,099	820,099
Bis (2-Ethyl Hexyl) Phthalate	794,416	794,416	794,416
Methylene Chloride	730,743	669,207	653,823
Nickel	528,218	528,218	528,218
Formaldehyde	485,158	485,158	456,619

TABLE 5-16. INCREMENTAL RANKING FOR LANDFILLING

	Compound	Incremental Value
>1000	Arsenic	51,000
	PCBs	16,941
	Chlordane	3,198
	Toxaphene	2,045
	Bis(2-ethyl hexyl) phthalate	1,100
100-1000	NO POLLUTANTS	
1-100	Trichloroethylene	56
	Benzene	50
	Cyanide	4.1
	Mercury	3.3
<1	NO POLLUTANTS	

Source: Reference No. 16

TABLE 5-17. INCREMENTAL RANKING FOR LAND APPLICATION

Toxicity to Soil Biota Predators	
Cadmium	81.4
Aldrin/Dieldrin	1.5
Phytotoxicity	
Cadmium	7.1
Chromium	1.4
Animal Toxicity from Plants	
Cadmium	1.0
Human Toxicity from Plants	
PCB	14953.0
Chlordane	3100.0
Aldrin/Dieldrin	1300.0
Toxaphene	1245.0
Cadmium	95.0
Arsenic	1.5
Mercury	1.0
Human Toxicity from Animal Products Fed on Plants	
PCB	64953.0
Toxaphene	1345.0
Chlordane	180.0
Aldrin/Dieldrin	100.0
Heptachlor	7.0
Mercury	2.75
Cadmium	2.5
Human Toxicity from Animals Ingesting Sludge	
PCB	33947.0
Aldrin/Dieldrin	9090.0
Toxaphene	1845.0
Chlordane	448.0
Hexachlorobutadiene	130.0
Mercury	12.5
Cadmium	2.2
Toxicity from Soil Ingestion	
Arsenic	3100.0
PCB	171.0
Aldrin/Dieldrin	40.0
Chlordane	33.0
Toxaphene	21.0
Hexachlorobutadiene	8.9
Mercury	1.9
Cadmium	1.4

TABLE 5-17. INCREMENTAL RANKING FOR LAND APPLICATION (Continued)

Human Aggregate Toxicity	
PCB	109937.0
Aldrin/Dieldrin	11090.0
Toxaphene	4445.0
Chlordane	3900.0
Cadmium	100.0
Mercury	21.4
Nickel	11.9

Source: Reference No. 16

the sludge indices for land application. Arsenic and organic compounds such as bis(2-ethylhexyl)phthalate, trichloroethylene, and benzene are problems with landfilling. On the other hand, certain metals and organics appearing in large concentrations as determined by the 40 POTW study appear to have little impact on ground water quality. Pollutants identified by EPA as problems when landfilled or land applied, but not found to contribute major loadings in the study are: zinc, molybdenum, copper, iron, hexachlorobenzene, benzo(a)pyrene, DDT, heptachlor, lindane, and dimethylnitrosamine.

For the most part, the pollutants of concern from the sludge indices are the same as those identified as being of concern in the DSS. Many pollutants that were identified in the DSS as being of low concentration in the sludge, such as chlordane or toxaphene, are still important in an overall analysis of toxics in sludge. It is evident from the sludge indices that mass of pollutants is not as important as a pollutant's toxicity. Thus, low level concentrations of a pollutant, such as arsenic, are a significant risk if that sludge is to be landfilled or landfarmed.

The sludge analysis has demonstrated that a potential for contamination of surrounding or underlying soil and/or ground water does exist from disposal of sludge containing DSS pollutants. An analysis of this type, nonetheless, has many limitations; ground water contamination is a new field of study with little available data on either ground water levels or the factors that affect pollutant migration to ground water. Studies on contamination of land from sludge disposal have largely focused on PCBs and cadmium and not on the prevalent DSS or other priority pollutants.

5.5 CONCLUSIONS

The assessment of effects has been encumbered by the lack of specific criteria and data on the distribution of DSS pollutant discharges to POTWs. To the extent possible, this study estimated pollutant-specific loadings to each of the respective receiving media. These data then were used, along with supporting evidence from case studies, to make predictions on the possible effects that could be expected from these discharges.

The analysis predicted that between 82 and 92 percent of the hazardous constituents could be removed from the wastestream by POTWs. The partitioning of the pollutants will vary within chemical classification and type of treatment system (acclimated and unacclimated).

Assessing effects in surface water requires an understanding of the environment in which these POTWs discharge. Of those POTWs evaluated, a majority discharge to small streams (i.e., these streams allow for a dilution capacity of less than 25 to 1). Two separate assessments were conducted on the effects of surface water discharges: an analysis of projected exceedances of water quality criteria; and an evaluation of incidents demonstrating effects from DSS discharges. Using two data bases, an evaluation of water quality criteria exceedances was conducted for current conditions and after PSES conditions. In both cases, exceedances were associated with both median and low flow conditions at well-run secondary plants. Bioassays conducted on POTWs with significant industrial contributions have demonstrated high levels of toxicity to aquatic organisms. Many of these incidents have been tied to industrial discharges. In many cases, a specific pollutant has been identified as the cause for the toxicity. In other cases, the pollutant has not been identified. Additionally, the data show that environmental effects are not necessarily related to the mass loading of the pollutants. Often, the toxicity of a compound is primarily responsible for an effect, while the concentration is only a secondary factor.

Effects from hazardous waste air emissions are difficult to characterize. Between 24 and 42 percent of the volatile pollutants are emitted to the air. Until recently, little attention was paid to volatile releases from POTWs. While the direct source to the air is the POTW, the "actual" sources of a large percentage of these pollutants are industrial users. Sampling and analysis in Philadelphia served to heighten the awareness of how significant POTW industrial users are as sources to total VOC emissions. This and other studies have evaluated the potential risk to human life from uncontrolled emissions emanating from a POTW. An immediate concern relates to the effects on POTW workers of exposure to volatile compounds. There are 10 demonstrated incidences of illness and 1 death from volatile emissions in POTWs. One reason that only 10 cases have been reported is that the odor threshold for most of the volatile pollutants are above the toxicity level. Hence, while adverse exposure could be occurring, pollutant levels are such that the worker is unaware of the exposure. The pollutants shown to be released from POTWs to the air are toxic and have significant health effects associated with their exposure. Many of the pollutants identified in this study as a concern for air emissions are now being considered for regulation by EPA under Section 112 of the Clean Water Act.

There are six possible pathways for contamination of ground water from POTW effluent:

- Exfiltration from sewers
- Leaks from discrete unit operations at the wastewater treatment plant
- Land application of municipal sludge
- Wastewater treatment lagoons
- Land treatment of municipal wastewater
- Deep well injection.

Because hazardous wastes are being discharged to sewers and infiltration is a known problem with sewers, exfiltration may potentially produce ground water contamination. Of the six possible pathways, exfiltration is the least known and merits further study. Municipal sludge disposal and land treatment either are regulated or are under consideration for regulation. Wastewater treatment lagoons are being studied. As with water quality, the pollutants that constitute the largest loadings to sludges are not the pollutants of concern for land disposal of sludge.

The major conclusion that must be drawn from this effects analysis is that further study is needed so that effects might better be assessed. In particular:

- Data on actual partitioning of hazardous pollutants in POTWs under acclimated and unacclimated conditions are essential.
- Increased monitoring is needed for measurement of volatile emissions from POTWs, looking at all volatile constituents, to determine the overall significance of this source.

- Further attention is warranted on detection and/or regulation of volatile emissions that might adversely impact worker health and safety.
- Ground water quality data need to be gathered to assist in an evaluation of municipal sludge disposal operations and POTWs as possible contributors to ground water degradation; POTW exfiltration warrants special attention.
- More data need to be collected from bioassay programs. These should be tied to full chemical characterization of the wastestream.
- Sludge criteria should be developed, implemented, and enforced.

The preceding sections of this chapter have attempted to define the effects of hazardous pollutant discharges to POTWs. Although some estimates have been made, the strongest conclusion from the study has been that more data are needed before effects can be assessed fully.

CHAPTER 6

EVALUATION OF GOVERNMENT CONTROLS ON HAZARDOUS WASTE DISCHARGES TO SEWERS

6. EVALUATION OF GOVERNMENT CONTROLS ON HAZARDOUS WASTE DISCHARGES TO SEWERS

In the preceding chapters, the objectives of the Domestic Sewage Study were presented and basic methods, such as pollutant selection, explained. Major sources, types, and quantities of hazardous wastes discharged to sewers were characterized and resultant releases to the environment and their effects considered. The purpose of this chapter is to describe the effectiveness of government programs in controlling the discharge of hazardous wastes to sewers. In order to accomplish this, it is necessary to understand the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA) and the interaction of these statutes as a result of the discharge of hazardous wastes to sewers, allowed under RCRA's Domestic Sewage Exclusion. In addition, other statutes that may control effects associated with the discharge of hazardous wastes to sewers may be relevant, including the Occupational Health and Safety Act, the Clean Air Act, and the Comprehensive Environmental Response, Compensation, and Liability Act. (State and local laws also control such effects to varying degrees.) The applicability of recent Agency efforts to protect ground water is also discussed.

This chapter takes the following approach in explaining how hazardous wastes come to be discharged to sewers and how existing government controls regulate them:

6.1 - Rationale for Hazardous Waste Discharges to Sewers - brief overview of RCRA and CWA; discussion of origins and implications of the Domestic Sewage Exclusion and other routes by which POTWs receive hazardous wastes.

6.2 - Statutory Mechanisms Controlling Hazardous Waste Discharges - detailed analysis of RCRA, CWA, and other statutes which may regulate DSE wastes; focuses especially on RCRA generator and TSDF requirements and CWA pretreatment program.

6.3 - Evaluation of the Effectiveness of Pretreatment - examination of the ability of pretreatment controls to address DSE wastes at the National and local level.

6.4 - Conclusions - summary assessment of regulatory mechanisms under RCRA, CWA, and other statutes affecting hazardous waste discharge to POTWs.

6.1 RATIONALE FOR HAZARDOUS WASTE DISCHARGES TO SEWERS

6.1.1 RCRA/CWA Overview

This subsection briefly describes generation and treatment, storage and disposal obligations under RCRA, and wastewater treatment and pretreatment requirements under the CWA so that the reader has sufficient background to understand the operation of the Domestic Sewage Exclusion. More detailed discussions of RCRA and CWA are provided in Section 6.2 of this chapter.

The goal of the RCRA program is to require "cradle to grave" management of hazardous wastes. RCRA coverage begins when a person or firm produces a waste. The firm is required to categorize its waste, applying a two-part regulatory test. First, the waste producer must determine if the waste is a "solid waste," since, under RCRA, only solid wastes can be deemed hazardous wastes. If the waste is a solid waste, then the firm is obligated to determine if it is also a hazardous waste (either a characteristic or listed waste). The person or firm producing a waste which is hazardous is termed a generator under RCRA. Generation of a hazardous waste marks the "cradle" in the cradle-to-grave management chronology. Transportation, treatment, storage and disposal of this hazardous waste then must be subject to a paper trail and hazardous waste management requirements under RCRA. A generator must notify EPA that he has produced a hazardous waste and must receive an EPA identification number. If he ships the waste offsite for treatment, the receiving treatment, storage and disposal facility must be authorized under RCRA to receive the waste.

If the hazardous waste is transported off the generator's property, the transporter is regulated by the hazardous waste management system, including relevant Department of Transportation regulations. Further, the person accepting such waste for treatment, storage, or disposal is also subject to the RCRA regulatory framework, and thus must notify the Agency of this activity. In accord with this scheme, over 73,000 generators, transporters, and treatment, storage, and disposal facilities (TSDFs) of hazardous wastes have notified EPA and the States (see Figure 6-1, taken from Summary Report on RCRA Activities -- September, 1985, dated November 5, 1985). This number is

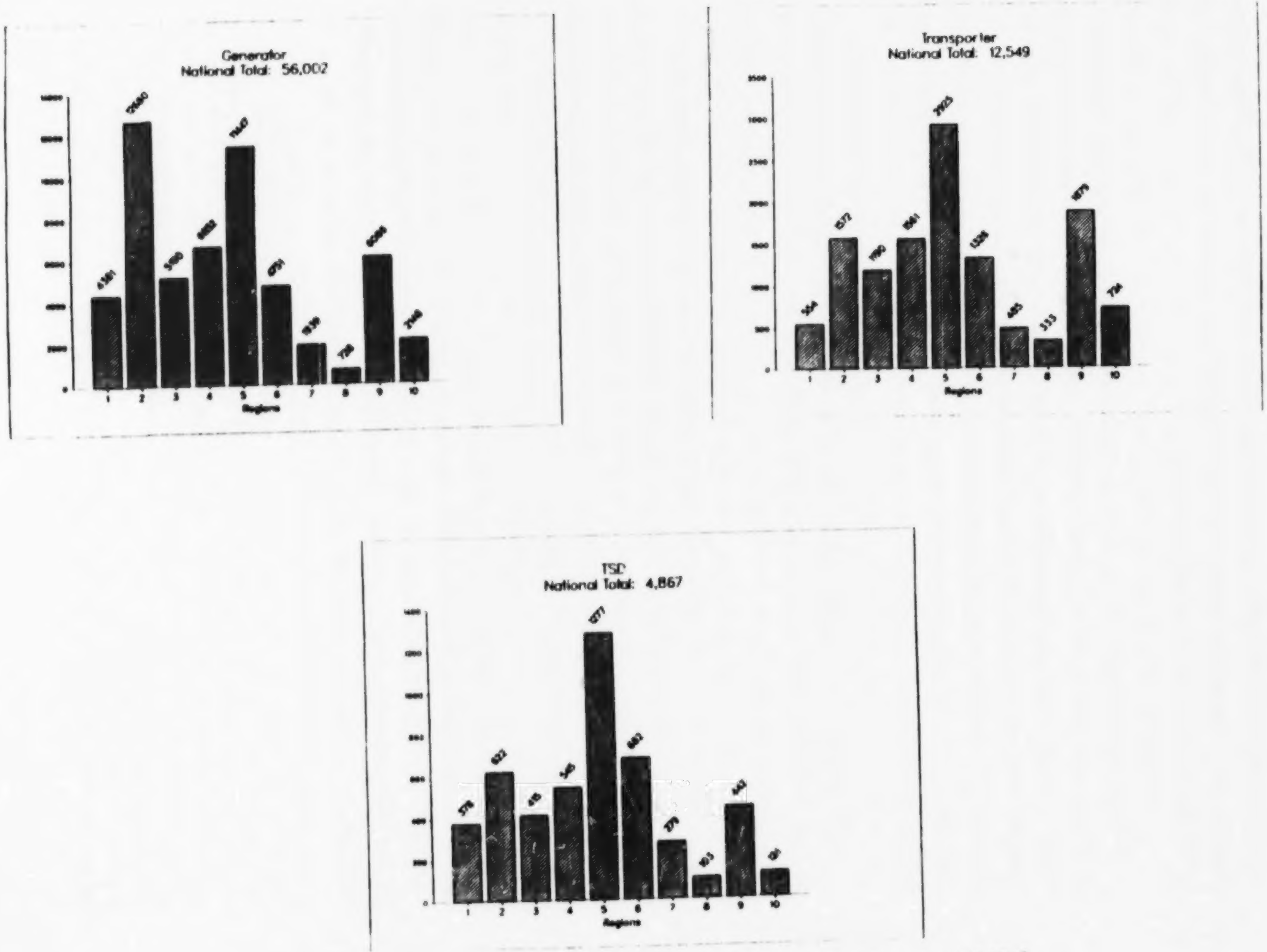


FIGURE 6-1. GENERATORS, TRANSPORTERS, AND TSD'S (As of 9/30/85)

expected to soon increase by another 100,000 to 175,000 establishments as the new requirements for small quantity generators are imposed in the 1984 RCRA Amendments. Hazardous waste TSDFs are subject to permitting requirements in addition to notification requirements.

Hazardous wastes may be treated and then disposed in ways affecting all environmental media -- air emissions from incinerators, wastewater discharges from treatment systems, underground injection, soil and ground water contamination from land treatment and disposal. The RCRA program controls disposal of hazardous waste no matter what environmental media are involved. The regulatory interest is in the management of hazardous waste, not just the manner of disposal.

In contrast, the Clean Water Act principally protects one medium, the Nation's waters, and accomplishes this by controlling the discharge of pollutants from point and nonpoint sources. Although there are provisions of CWA which require an assessment of environmental effects on other media, these are aimed at incidental benefits rather than serving as central objectives.[1] The primary target of CWA is the wastewater discharger, whether that facility discharges directly to the Nation's waters or indirectly, through a POTW. This DSS report evaluates indirect dischargers to POTWs, parties controlled by the National Pretreatment Program.

Whereas the RCRA program regulates any waste defined as hazardous, the focus of CWA pretreatment programs is, first, on 34 industrial categories and 126 toxic pollutants, although it may, by statute, regulate additional pollutants and industries. These industries are commonly referred to as categorical industries and the 126 toxic pollutants are referred to as priority pollutants. Indirect dischargers that are categorical industries must make sure that wastewaters they discharge to publicly owned treatment works (POTWs) comply with National pretreatment standards promulgated by EPA. Industrial wastewaters, discharged by any nondomestic source to sewers, which might do harm to POTWs or the environment, are regulated by specific prohibitions under the pretreatment program. In addition, to ensure site-specific regulation of indirect dischargers (also commonly referred to as industrial users or "IUs,") approximately 1,500 POTWs nationally have been required to have Federally approved local pretreatment programs. POTWs with Federal programs are required to develop and implement additional procedural and substantive controls (e.g., industrial waste surveys, local limits, etc.) to protect plants and the environment. Other POTWs, not subject to general pretreatment requirements, are also required to develop local limits when pollutants cause interference or pass through and such violations are likely to recur.

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[1] Section 201 requires the Administrator to encourage waste management which will result in "...the ultimate disposal of sludge in a manner that will not result in environmental hazards." Section 304 requires that, in developing technology-based guidelines, the Agency consider nonwater quality impacts. The pretreatment regulations require that POTWs develop programs capable of protecting sludge quality. The criteria for evaluating alternative waste management techniques employing land application and land utilization practices requires that the ground water affected meet drinking water standards for aquifers which can be potentially used for drinking water supply.

The universe of facilities affected by the pretreatment program numbers nearly 1,500 POTWs, approximately 14,000 categorical industries, and an unknown number of noncategorical industries. In addition, all 15,000-plus POTWs must enforce general and specific prohibitions contained in the General Pretreatment Regulations. The RCRA program regulates about 73,000 generators, transporters, and treatment, storage, and disposal facilities. It should be noted that some facilities are regulated by both programs. Of special interest to the Domestic Sewage Study are RCRA generators which are indirect dischargers and POTWs which receive these wastes, either as a RCRA TSDF or otherwise.

6.1.2 The Domestic Sewage Exclusion: Origins and Implications for Generators/Industrial Users

This subsection explains how and why generators/IUs are allowed, under RCRA, to discharge hazardous wastes to sewers as a result of the so-called Domestic Sewage Exclusion (DSE). The DSE excludes "any mixture of domestic sewage and other wastes that pass through a sewer system to a publicly owned treatment works for treatment" from being defined as solid waste under RCRA. For a waste to be considered hazardous under RCRA, it must first be a solid waste. Since this regulation provides that any indirect wastewater discharges mixed with sewage in the sewer cannot be considered a solid waste, the practical effect of the DSE is to exempt all industrial discharges that mix with domestic wastes in the sewer system from RCRA manifesting and management requirements, with the exception of RCRA notification requirements. It should be noted that the exclusion is not explicitly conditioned on compliance with other environmental controls (e.g., CWA, pretreatment standards) but on the basis that a waste which is not defined as a RCRA solid waste cannot be a hazardous waste.

6.1.2.1 Origins of the DSE

The DSE originated in the Solid Waste Disposal Act (SWDA) of 1965. The 1965 Act authorized limited research and grant programs to study solid waste disposal practices, but excluded research on domestic sewage disposal from inclusion, since construction grants were available under the Federal Water Pollution Control Act to study and treat domestic sewage. The exclusion, at this point, was not regulatory in nature, and did not revolve around the distinction between solid and hazardous wastes, mentioned above.

The Resource Conservation and Recovery Act of 1976 (amending the SWDA) required regulatory controls for dumping of solid wastes and for the generation, transportation, treatment, storage, and disposal of hazardous wastes. The 1976 Act included the DSE in Section 1004(27) as a carry-over from the 1965 Act, although the legislative history did not specifically address the intent behind the exclusion.

The 1980 RCRA regulations, implementing the 1976 Act, interpreted the DSE to apply both to sanitary sewage and to mixtures of sanitary wastes with other wastes in a sewer system as discussed above [See 40 CFR 261.4(a)(1)]. This interpretation was based upon the Agency's determination that the legislative policy reflected in the 1965 Act would also exempt mixed wastestreams since they too would be subject to controls under the Clean Water Act. The preamble to the 1980 RCRA regulations stated that not only did the construction grants program provide financial assistance for the proper treatment of such wastes, but that the pretreatment program also provided a basis to assure that environmental problems did not result (See 45 FR 33097, May 19, 1980).

The preamble did point out, however, that the exclusion was not based upon any determination about the health and environmental risks presented by such waste streams. As a matter of fact, the preamble acknowledged, some mixtures of domestic sewage with other wastes may indeed present environmental risks.

6.1.2.2 Regulatory Interpretation of the DSE

The Agency interpreted the exclusion to apply solely to wastes discharged to POTWs, because only public sewage treatment plants are subject to the construction grant and pretreatment programs. Consequently, the DSE is not available to privately owned treatment works. The rationale for the DSE is not that wastes mixed with domestic sewage are rendered harmless, but that sufficient regulatory controls existed via the Clean Water Act, in particular through the pretreatment program.

Another basic issue surrounding the DSE is when it takes effect. Since the exemption only applies to nondomestic wastes which mix with domestic sanitary wastes in a POTW, it is necessary to determine just when mixing occurs. The Agency's interpretation is that the exemption begins when the waste "...first enters a sewer system that will mix it with sanitary wastes prior to storage or treatment by a POTW" (*Federal Register* 33097, May 19, 1980 emphasis added). Thus, the DSE may actually apply prior to actual mixing with domestic sewage. The location and timing of the application of the exclusion are also important because solid wastes may be deemed hazardous and subject to RCRA requirements until "first entry." Industrial user responsibilities under RCRA and the DSE are discussed further in Section 6.2 of this chapter.

6.1.3 Implications of DSE for POTWs and Other Routes for Hazardous Waste Discharge to Sewers

As explained above, an industrial user, discharging wastes to sewers pursuant to the DSE, is not releasing solid wastes, and by definition not releasing hazardous wastes, to the POTW. Likewise, the POTW receiving these wastes (hereinafter referred to as DSE wastes) is not receiving hazardous wastes. Therefore, the POTW does not automatically become a treatment, storage, and disposal facility as would other offsite waste treatment facilities under RCRA. Instead the POTW is simply receiving an industrial wastewater discharge which may be subject to National and local pretreatment standards. The only way that the POTW, receiving DSE wastes (and no other hazardous waste) enters RCRA's hazardous waste management program is if, as a result of wastewater treatment, the POTW produces a sludge which is determined to be hazardous when tested under RCRA testing procedures (i.e., extraction procedures (EP) toxicity). The POTW that produces a hazardous sludge is a generator subject to RCRA notification, identification, recordkeeping, and waste management requirements. It should be noted that using current extraction procedures, few, if any, municipal sludges have been identified as hazardous. If the POTW, in turn, decides to treat, store, or dispose of its own hazardous sludge onsite, it also becomes a TSDF, subject to RCRA management and permitting controls. If it ships its hazardous sludge offsite for treatment or disposal, the POTW must comply with recordkeeping, manifesting, and other controls imposed on hazardous waste generators. In Section 6.2 of this chapter, a detailed discussion of POTW responsibilities as a hazardous waste generator and/or TSDF are presented.

POTWs are regulated under RCRA by a second method if they receive hazardous wastes by truck, rail, or dedicated pipe. POTWs accepting hazardous waste in this manner are considered TSDFs. However, since these POTWs are subject to environmental permitting under the CWA's National Pollutant Discharge Elimination System, under EPA regulation these facilities are eligible for a RCRA permit-by-rule provided certain requirements are satisfied. Further discussion is also provided in Section 6.2 on RCRA permit-by-rule provisions. Under permit-by-rule requirements and the General Pretreatment Regulations, a POTW may not accept hazardous waste received by truck, rail, or dedicated pipe unless the wastes meet Federal and local pretreatment requirements. In practical terms, then, hazardous wastes received by these transport methods must be treated by industry to the same extent that DSE wastewater discharges are to comply with pretreatment standards. However, POTWs receiving wastes by these transport methods need a RCRA permit, while those receiving only DSE wastes do not. This distinction has consequences for the corrective action requirements under the Hazardous Solid Waste Amendments of 1984, discussed later.

6.2 RELEVANT RCRA, CWA, AND OTHER STATUTORY/REGULATORY REQUIREMENTS

The sections above introduced the Domestic Sewage Exclusion and described generally how it affects industrial user and POTW responsibilities under RCRA, both in terms of generation and treatment, storage, and disposal obligations. This subsection provides a more detailed analysis of hazardous waste management under RCRA and applicable CWA controls on IUs and POTWs, including pretreatment, permitting, and sludge disposal requirements. A discussion of OSHA, Clean Air Act, and CERCLA provisions affecting hazardous wastes discharged to sewers is also included.

6.2.1 RCRA's "Cradle to Grave" System

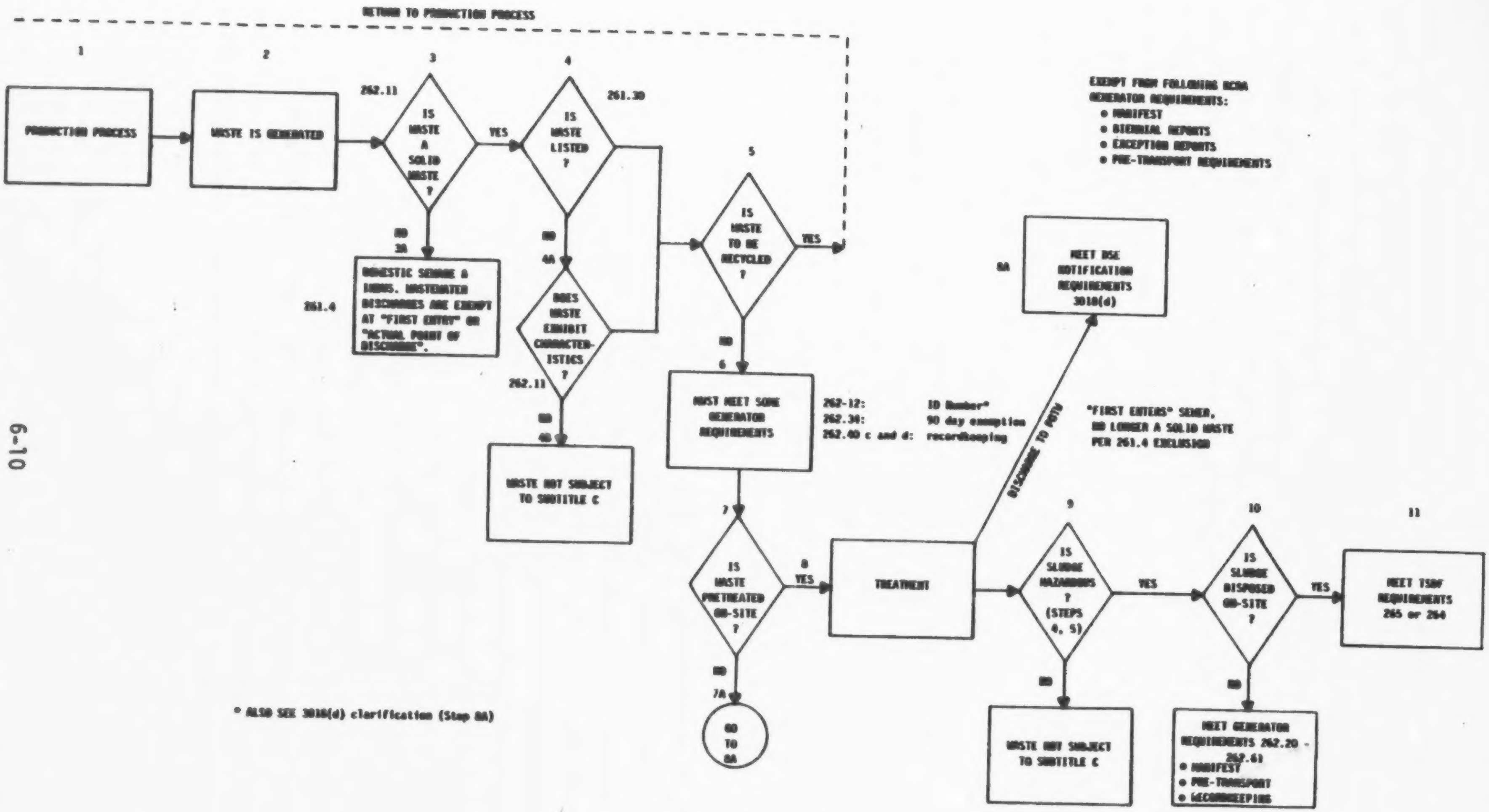
6.2.1.1 Waste Identification and Notification

As discussed briefly above, RCRA's regulatory framework is triggered by the determination that a solid waste is a hazardous waste. The Agency has established two methods by which a solid waste may be determined to be hazardous: (1) if it exhibits hazardous waste characteristics (ignitability, corrosivity, reactivity, and EP toxicity); or (2) if it is listed as such by the Agency. These were discussed previously in Chapter 2.

Finally, a solid waste may be a hazardous waste if it is a waste mixture, composed of both a hazardous waste and a solid waste. In the case of a waste mixture composed of a listed hazardous waste and a solid waste, the mixture rule (40 CFR 261.3) applies and the solid waste must be handled as a hazardous waste when the listed waste is added. On the other hand, a solid waste mixed with a nonlisted characteristic waste or a waste listed because it exhibits hazardous characteristics need not be a hazardous waste if it does not exhibit the characteristics of a hazardous waste. Steps 1-5 of Figure 6-2 show how a waste is considered to be a hazardous waste.

6.2.1.2 Notification Requirements

RCRA 3010(a) requires that any person (generators, transporters, and treatment, storage, and disposal facilities) handling a hazardous waste must file a notification within 90 days of the first EPA regulations identifying


RETURN TO PRODUCTION PROCESS
1
PRODUCTION PROCESS
2
WASTE IS GENERATED
3
262.11
IS WASTE A SOLID WASTE ?
YES
NO
3A
261.4
DOMESTIC SEWAGE & INDUS. WASTEWATER DISCHARGES ARE EXEMPT AT "FIRST ENTRY" OR "ACTUAL POINT OF DISCHARGE".
4
261.30
IS WASTE LISTED ?
NO
4A
DOES WASTE EXHIBIT CHARACTER-ISTICS ?
262.11
NO
4B
WASTE NOT SUBJECT TO SUBTITLE C
5
IS WASTE TO BE RECYCLED ?
YES
NO
6
MUST MEET SOME GENERATOR REQUIREMENTS
262-12: ID Number*
262.34: 90 day exemption
262.40 c and d: recordkeeping
7
IS WASTE PRETREATED ON-SITE ?
8
YES
NO
7A
GO TO 8A
TREATMENT
DISCHARGE TO POTW
8A
MEET DSE NOTIFICATION REQUIREMENTS 3010(d)
EXEMPT FROM FOLLOWING RCRA GENERATOR REQUIREMENTS:
• MANIFEST
• BIENNIAL REPORTS
• EXCEPTION REPORTS
• PRE-TRANSPORT REQUIREMENTS
"FIRST ENTERS" SEWER, NO LONGER A SOLID WASTE PER 261.4 EXCLUSION
9
IS SLUDGE HAZARDOUS ? (STEPS 4, 5)
YES
NO
WASTE NOT SUBJECT TO SUBTITLE C
10
IS SLUDGE DISPOSED ON-SITE ?
YES
NO
MEET GENERATOR REQUIREMENTS 262.20 - 262.61
• MANIFEST
• PRE-TRANSPORT
• RECORDKEEPING
11
MEET TSDF REQUIREMENTS 265 or 264

* ALSO SEE 3010(d) clarification (Step 8A)

FIGURE 6-2. WHEN IS A WASTE A HAZARDOUS WASTE?
THE CASE OF THE INDUSTRIAL USER

wastes as hazardous. (For subsequent regulations identifying wastes as hazardous, notification is required when expressly called for by EPA.)

6.2.1.3 Generator Requirements

A generator of hazardous waste must have an EPA identification number (see 40 CFR 262.12) prior to transporting, treating, storing, or disposing of the hazardous waste. A regulated generator also must not deliver hazardous waste to any transporter or treatment, storage, and disposal facility that does not have an EPA identification number itself. Generators also need to keep records of test results, waste analyses, or any other determination that their waste is a hazardous waste for at least three years from the date the waste was last sent for treatment, storage, or disposal (40 CFR 262.40). These aspects of generator requirements are shown as step 6 of Figure 6-2 and must be met by facilities that treat, store, or dispose onsite as well as those that treat, store, or dispose offsite.

If a generator plans to treat, store, or dispose of a waste offsite, the generator must fill out an EPA a manifest form containing the following information for each load of hazardous waste shipped:

- Generator name, address, telephone number and EPA identification number
- Transporter name and EPA identification number
- Name, address, and EPA identification number of permitted facility receiving waste
- Description of hazardous wastes transported
- Waste quantities, types, and number of containers
- Certification for proper packaging, marking, labeling and transportation
- Waste minimization certification
- Manifest document number.

Upon delivery of waste to the transporter, the generator should sign and date the manifest, have the transporter sign the manifest, retain one copy, and provide the transporter with all remaining copies. A generator who does not receive, within 35 days, a manifest copy signed by the facility designated to receive the waste must contact the transporter and designated facility to determine what happened to the waste. The generator who has not received, within 45 days, a signed manifest copy must submit an exception report to the EPA Region.

Before transporting any hazardous waste offsite, a generator must comply with packaging, labeling, marking, and placarding requirements. Generators that ship their hazardous wastes offsite must prepare and submit a report to the appropriate EPA Region of each even-numbered year. This report covers hazardous waste generator activities during the previous odd-numbered calendar year.

6.2.1.4 IU Responsibilities as a Generator[2]

As discussed above, the Domestic Sewage Exclusion goes into effect when the wastes "first enter" the system. However, this exclusion does not work to exempt an industrial user from all RCRA requirements. If the industrial user generates a waste during the production process, and if that waste fits the extremely broad definition of a solid waste (step 3), then unless the solid waste is excluded under the 261.4 exemptions (step 3A), the generator must test to see if the solid waste is a hazardous waste.

RCRA and the implementing regulations define the term solid waste broadly. According to 40 CFR 261.2, a solid waste is any "discarded material" not specifically excluded from the definition. This may include solid, liquid, semisolid, or contained gaseous materials. It also includes certain waste materials which are recycled or reclaimed.

The next step (3A) is to determine whether the waste is excluded. Two significant exclusions are the DSE, discussed before, and the wastewater treatment exemption which applies to industrial wastewater discharges for point source discharges subject to NPDES permits. Both exclusions have limits to their application.

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[2] All steps refer to Figure 6-2.

In the case of the domestic sewage exemption, the preamble to the May 19, 1980 RCRA regulations (Fed. Reg. 33097) state that the exemption takes effect when the waste "...first enters..." the sewer system. Consequently, if a solid waste was generated prior to entry, the dischargers would need to meet steps 4A, 4B, and 5, and thereby determine whether the solid waste was a hazardous waste. If so, the discharger must obtain an identification number and meet applicable recordkeeping requirements, e.g., maintenance of test records. These are the same requirements that need be met by all generators who treat, store, or dispose of hazardous wastes onsite.

This view is consistent with the Agency's interpretation of the limitations on the industrial wastewater exclusion, which appears as a comment to 40 CFR 261.4. The substance of the comment is that the exclusion of industrial wastewater discharges from the definition of solid waste "...applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored, or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment." Consequently, an IU whose discharge is destined for treatment at a POTW is not exempted from all generator requirements if he generates a hazardous solid waste. Such dischargers must test to see if the solid waste is hazardous, and if it is hazardous, notify the Agency of generator activities, obtain an ID number and maintain records of testing for hazardousness (step 6).

If the waste is discharged to a POTW prior to any treatment, storage, or disposal at the facility, at "first entry" the hazardous waste is no longer a solid waste or, consequently, a hazardous waste. The DSE defines away the regulated status of the discharge, although it may actually retain the characteristics of a hazardous waste. The generator is excluded from further RCRA generator requirements, including manifesting, pretransport requirements, recordkeeping requirements for the manifest, and reporting requirements. If the waste is treated onsite, any sludges generated from the facility's wastewater treatment operation must also be tested for hazardousness (step 9). Thus, the IU's responsibilities under a DSE scenario are similar to the generator with an onsite treatment, storage, or disposal facility. This appears to give IUs an incentive not to treat wastes prior to discharge to the sewer. However, pretreatment requirements directly counter this result by mandating treatment to achieve limits.

Although the DSE simplifies some industrial user RCRA responsibilities, it complicates industrial users' RCRA reporting responsibilities. Do they need to notify, must they receive an EPA identification number, etc.? Section 3018(d) of RCRA, added by the 1984 Amendment, clarifies that Section 3010 notification requirements apply to "...solid or dissolved material in domestic sewage...." However, the Agency has not yet implemented this provision. Notification forms have not been changed, and, apparently, few IUs have notified.[3]

6.2.1.5 POTW Responsibilities as a Generator

As discussed previously, a POTW may generate sludge with hazardous characteristics as a result of the receipt of domestic and nondomestic wastes. In this event, the POTW, like the IU, must meet all generator requirements for these sludges. Also, like the industrial user, the type of generator requirements with which the POTW must comply differ depending on whether the waste is disposed on or offsite. If the hazardous waste is to be treated, stored, or disposed offsite, the generator must meet manifesting, pretransport, and certain recordkeeping and reporting functions with which an onsite TSDF would not need to comply with. Figure 6-3 illustrates POTW generator responsibilities.

Incidentally, even if a POTW's sludge is not hazardous, the receipt of hazardous waste may influence its ability to dispose of its sludge under the land disposal criteria of Subtitle D of RCRA (40 CFR 257). 40 CFR 257 establishes criteria to determine which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on human health or the environment. The criteria also provide guidelines for sewage sludge use and disposal under Section 405(d) of CWA. These land disposal regulations

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[3] Since January of last year, the number of generators which appear in HWDMS as notifiers has increased by about 6,800 (56,002 - 49,236 = 6,766). Source: Summary Reports of RCRA Activities, OSW, USEPA. However, it has not been determined why the increase has occurred, and it may have very little to do with IU notifications.

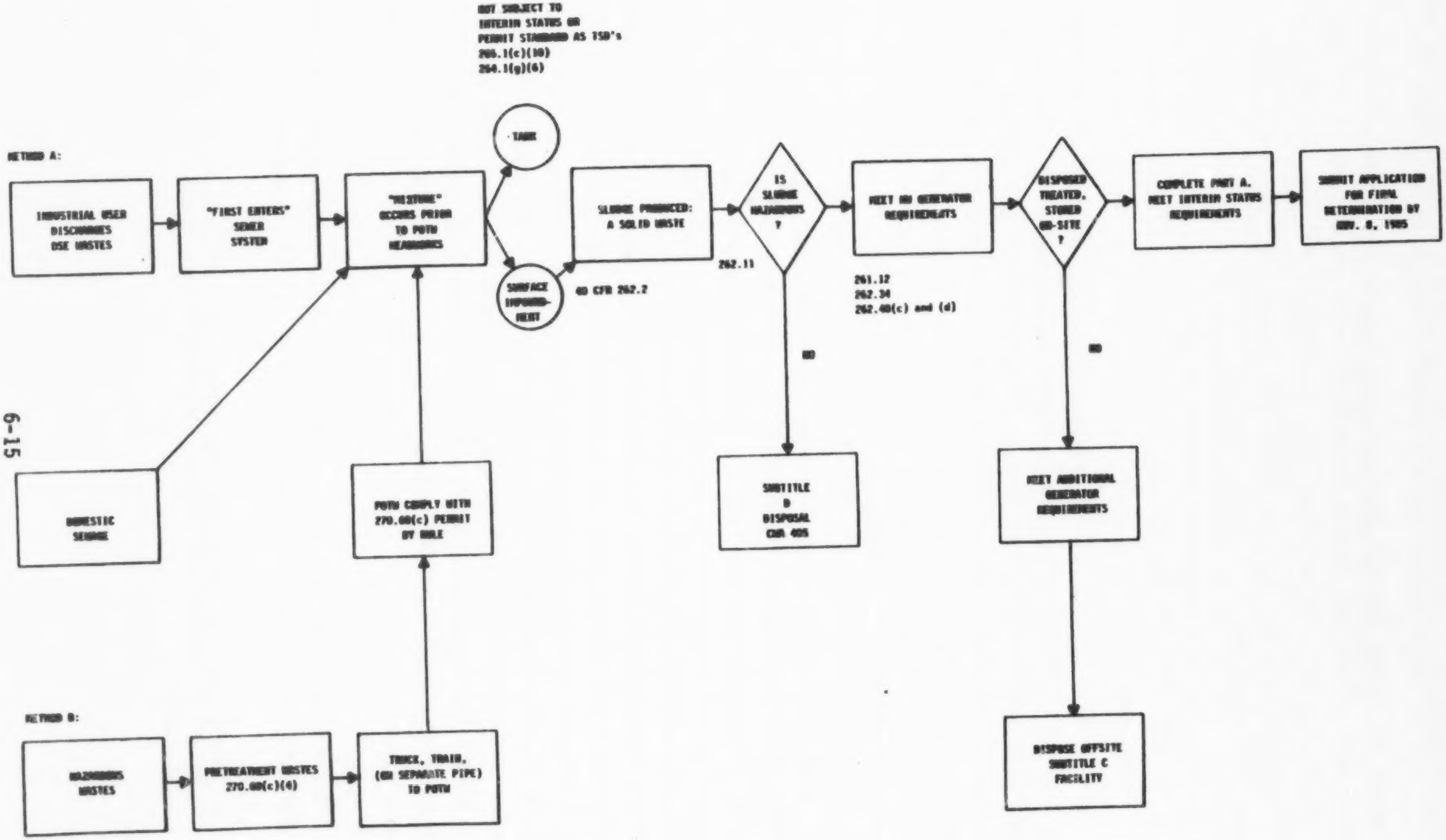
NOT SUBJECT TO
INTERIM STATUS OR
PERMIT STANDARD AS TSD's
265.1(c)(10)
264.1(g)(6)
METHOD A:
INDUSTRIAL USER
DISCHARGES
DSE WASTES
"FIRST ENTERS"
SEWER
SYSTEM
"MIXTURE"
OCCURS PRIOR
TO POTW
HEADWORKS
TANK
SURFACE
IMPOUND-
MENT
40 CFR 262.2
SLUDGE PRODUCED:
A SOLID WASTE
262.11
IS
SLUDGE
HAZARDOUS
?
NO
SUBTITLE
D
DISPOSAL
CWA 405
MEET HW GENERATOR
REQUIREMENTS
261.12
262.34
262.40(c) and (d)
DISPOSED
TREATED,
STORED
ON-SITE
?
NO
MEET ADDITIONAL
GENERATOR
REQUIREMENTS
DISPOSE OFFSITE
SUBTITLE C
FACILITY
COMPLETE PART A.
MEET INTERIM STATUS
REQUIREMENTS
SUBMIT APPLICATION
FOR FINAL
DETERMINATION BY
NOV. 8, 1985
DOMESTIC
SEWAGE
POTW COMPLY WITH
270.60(c) PERMIT
BY RULE
METHOD B:
HAZARDOUS
WASTES
PRETREATMENT WASTES
270.60(c)(4)
TRUCK, TRAIN,
(OR SEPARATE PIPE)
TO POTW

FIGURE 6-3. THE POTW AS A GENERATOR AND TSDF

prohibit any sludge disposal practices that lead to the contamination of ground water beyond the maximum contaminant levels established by the Safe Drinking Water Act. In addition, these regulations also prohibit the land application of any solid wastes containing cadmium and PCBs except under prescribed conditions.

6.2.1.6 TSDF Requirements

- Overview

The acronym TSDF stands for treatment, storage, and disposal facility. The majority of RCRA requirements deal with the regulation of these facilities. The terms "treatment," "storage," and "disposal" are defined in 40 CFR 260.10(a) and appear in Table 6-1. The term "facility" and "disposal facility" are defined in 40 CFR 260.10(a) as well. These terms also appear on Table 6-1. As can be seen from these definitions, a POTW which treats, stores, or disposes of hazardous wastes is a RCRA TSDF.

Section 3004 of RCRA lists minimum TSDF requirements that the Agency's regulations need to address (see Table 6-2). In response to this statutory mandate, the Agency has developed two sets of regulations, one set for "interim status" facilities (40 CFR 265) and a second set for "permitted" facilities (40 CFR 264). Interim status is conferred on qualifying existing TSD facilities until such time as they are issued a permit. The development of interim status was based on the realization by Congress in Section 3005(e) that an interim period was necessary to allow existing TSD facilities meeting certain interim standards to operate until such time as the Agency could issue a permit. A second set of standards, more stringent in many cases, are the Section 264 permitting standards. Figure 6-4 (taken from "Summary Report on RCRA Activities, September 1985") details the number of TSDFs projected to require permits.

In response to the Congressional mandate for TSDF regulations, the Agency fashioned the 264 and 265 requirements into the following subparts:

- General Facility Standards, including such things as waste analysis, security, inspection, personnel training requirements, and location standards

TABLE 6-1. RCRA DEFINITIONS FROM 40 CFR 260.10

"Treatment" means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste nonhazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

"Storage" means the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere.

"Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

"Disposal facility" means a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure.

"Facility" means all contiguous land, and structure, or other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).

TABLE 6-2. MINIMUM STATUTORY TSDF REQUIREMENTS

"(1) maintaining records of all hazardous wastes identified or listed under this title which is treated, stored, or disposed of, as the case may be, and the manner in which such wastes were treated, stored, or disposed of;

(2) satisfactory reporting, monitoring, and inspection and compliance with the manifest system referred to in Section 3002(5)

(3) treatment, storage, or disposal of all such waste received by the facility pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator

(4) the location, design, and construction of such hazardous waste treatment, disposal, or storage facilities

(5) contingency plans for effective action to minimize unanticipated damage from any treatment, storage, or disposal of any such hazardous waste

(6) the maintenance of operation of such facilities and requiring such additional qualifications as to ownership, continuity of operation, training for personnel, and financial responsibility (including financial responsibility for corrective action) as may be necessary or desirable

(7) compliance with the requirements of section 3005 respecting permits for treatment, storage, or disposal."

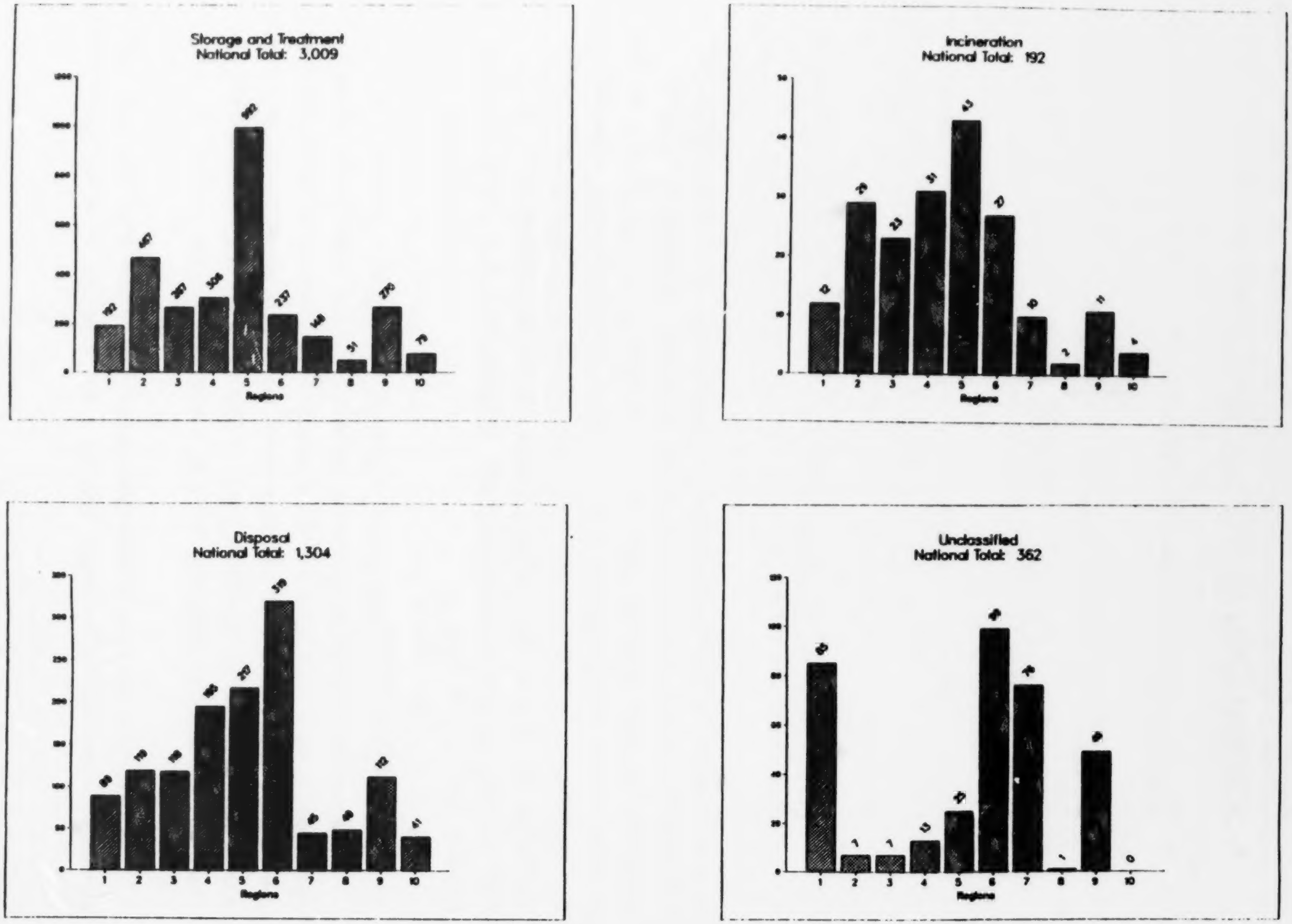

FIGURE 6-4. TSD'S PROJECTED TO REQUIRE PERMITS (As of 9/30/85)

- Preparedness and Prevention, including communication and emergency equipment plans
- Contingency Plans, discussing facility plans and actions to be taken in response to unplanned or hazardous situations
- Manifest, Recordkeeping, and Reporting, including the maintenance of operating records
- Ground Water Protection, including requirements for monitoring and, in the case of permitting standards, taking action to respond to releases
- Closure and Post-Closure, discussing means to control, minimize, or eliminate threats to human health and the environment upon the shutdown of a unit
- Financial Responsibility, including the demonstration of the facility's financial ability to close the facility, ensure post-closure care, and demonstrate financial responsibility for bodily harm and property damage to third parties
- Technical Standards for Treatment, Storage, and Disposal Facilities, with distinct requirements for tanks, surface impoundments, waste pile, land treatment, landfill, and incinerator facilities.

As stated above, all TSDFs must have interim status, or a RCRA permit, to continue to operate as a hazardous waste treatment, storage, or disposal facility. Certain types of hazardous waste management units (i.e., wastewater treatment tanks and elementary neutralization units) have been exempted from the requirements of 264 and 265. In addition, other types of facilities, including publicly owned treatment works, have been exempted from these requirements "...to the extent they are included in a RCRA permit by rule...." [40 CFR 264.1(e)].

- The POTW as TSDF

The permit-by-rule requirements appear in 40 CFR 270.60(c). These requirements were developed for POTWs accepting hazardous wastes brought to the POTW by truck, rail, or dedicated pipe for treatment (Federal Register, 33097, May 19, 1980). Therefore, the permit by rule does not cover all POTWs treating, storing, or disposing hazardous waste.

As described earlier, a hazardous waste discharged into the sewer system pursuant to the DSE is no longer legally a solid waste, or a hazardous waste, upon "first entry" into the system. However, a POTW can generate a "characteristic" hazardous waste, especially if it receives substantial concentrations of DSE wastes. Facilities generating hazardous wastes as a result of DSE influents would not be candidates for RCRA permits by rule unless they also received hazardous wastes by the modes of transport listed above.

6.2.1.7 Permit-by-Rule

A permit by rule has several important differences from a conventional RCRA TSDF permit with regard to the degree to which RCRA regulations apply. POTWs subject to RCRA permits by rule are only subject to a subset of RCRA requirements. According to 270.60(c), a POTW receiving hazardous waste by train, truck, or dedicated pipe for treatment may receive a RCRA permit by rule if the facility:

(1) Has a NPDES permit
(2) Complies with the conditions of the permit
(3) Complies with the following regulations
  (i) 40 CFR 264.11, identification number
  (ii) 40 CFR 264.71, use of manifest system
  (iii) 40 CFR 264.72, manifest discrepancies
  (iv) 40 CFR 264.73(a), and (b)(1), operating record
  (v) 40 CFR 264.75, biennial report
  (vi) 40 CFR 264.76, unmanifested waste report
(4) If the waste met all Federal, State, and local pretreatment requirements.

In the July 15, 1985 Federal Register, EPA promulgated the so-called "codification rule" modifying its regulations to reflect many of the 1984 Amendments. As part of that rule, EPA added Section 270.60(c)(3)(vii) requiring POTWs with permits issued after November 8, 1984 to comply with Section 264.101 corrective action requirements. That provision, also added in the July 15, 1985 Federal Register, has far ranging effects which are discussed below.

The substance of the permit-by-rule requirements, with the exception of the newly added corrective action requirement, has a dual purpose: (1) to "close the loop" of the manifest system, by requiring the POTW to meet manifest and reporting requirements; and (2) to ensure that all wastes received by truck, rail, or dedicated pipe at a POTW meet pretreatment requirements and are thus controlled by Clean Water Act authorities. This requirement acts to protect the POTW, sludge quality, and water quality.

In their current form, the permit-by-rule regulations do not include the remaining substantive requirements (i.e., surface impoundment technical standards, closure and post-closure care, and financial responsibility) with which TSDFs subject to individual RCRA permits must comply. The permit-by-rule was based on the assumption that the combination of pretreatment requirements and treatment at the POTW would provide sufficient protection to human health and the environment.

POTWs that generate hazardous waste and treat, store, and dispose of hazardous wastes are subject to more complete RCRA TSDF requirements. POTWs that do require conventional RCRA permits must meet not only the pre-HSWA Section 264 or 265 permitting or interim status requirements, but also newer HSWA requirements.

6.2.1.8 Corrective Action Requirement

RCRA contains two new corrective action provisions: (1) Section 3004(u) which provides that all facilities seeking a permit must conduct corrective actions for releases of hazardous wastes or constituents from solid waste management units; and (2) Section 3008(h) which provides the Agency with the enforcement authority to order an interim status facility to take corrective action at solid waste management units. The major difference between the two authorties is that the Section 3004(u) authority is nondiscretionary with respect to facilities subject to permitting requirements, whereas the 3008(u) enforcement authority is discretionary.

- §3004(u) Corrective Actions

As discussed above, a POTW may receive one of two types of RCRA permits: a permit by rule or an individual RCRA permit. Prior to the passage of Sections 3004(u) and 3008(h), RCRA's corrective action authorities were limited to taking action at regulated units at permitted facilities (Part 264 Subpart F) or using the imminent endangerment authority of 7003 (normally used in conjunction with CERCLA actions).

Before the enactment of the HSWA of 1984, the permit by rule did not require compliance with the corrective action requirements of Part 264 Subpart F. As a result of the enactment of Section 3004(u), EPA added a regulatory provision to its permit by rule regulations (§270.60) requiring POTWs to take corrective action for releases at solid waste management units within the facility boundary, whether or not those units now handle hazardous wastes. In addition, Section 3004(v) requires the Agency to develop regulations expanding the scope of corrective action authorities beyond the facility boundary. Facilities seeking RCRA permits after November 8, 1984 would be subject to 3004(u) corrective action for all units at the facility which release hazardous waste or hazardous constituents into the environment.

While the Agency does not plan to require corrective action unless it is necessary to protect human health and the environment, there may be substantial costs in determining whether or not a release had occurred in the past (e.g., sinking monitoring wells and analyzing results). Moreover, if corrective action is required, the Agency estimates potential costs of ground water cleanup at a one-quarter acre surface impoundment as a $249,000 annualized present value cost for counter pumping the plume and treating it. First year annualized costs for other source control methods ranged from $10,000 to $450,000 (Fed. Reg. 28738, July 15, 1985). Actual costs will differ based on site-specific conditions.

These costs were developed to reflect potential ground water contamination cleanup costs. However, the Agency is interpreting the provisions to encompass releases to all media, not only to ground water. As was described in Chapter 5, the potential exists that releases have also occurred to surface water and air. The costs of cleanup in these media have not been calculated. Nor has the Agency developed benchmark standards to determine cleanup levels, although it is working on developing such benchmarks.

- §3008(h) Corrective Actions

The 3008(h) authority is similar to the 3004(u) authority but its applicability is limited to interim status facilities. Consequently, facilities with permits by rule would not be subject to the interim status provision. However, POTWs that generate hazardous sludges and treat, store, or dispose of these sludges onsite as a result of the receipt of DSE wastes are subject to this interim status provision. If they seek operating or post-closure RCRA permits, they will also be subject to 3004(u)'s non-discretionary authority.

Note also that all POTW TSDFs, like all other locally, State, or Federally owned facilities, are now subject to annual inspections by EPA inspectors. This requirement appears in 3007(d) of RCRA, newly added by the HSWA.

6.2.1.9 Other HSWA Amendments

Other new statutory requirements may also have an effect on POTWs, although in a less direct manner. Section 3005(e)(2) requires that all land disposal facilities submit a final application for a permit and (Part 265) self-certification statement of compliance with RCRA interim status ground water monitoring and financial responsibility requirements by November 8, 1985 or lose interim status (unless a closure plan is submitted). This provision will have no direct impact on RCRA permitted POTWs unless they have ancillary treatment storage or disposal operations. The indirect implications of this provision on the POTW are potentially widespread and involve the disposal of increased amounts of hazardous wastes to the sewers in the absence of other disposal alternatives.

A land disposal facility may only receive hazardous wastes if it has either interim status or a permit. Given that only eight land disposal facilities have RCRA permits, this provision applies to about 1,600 interim status land disposal facilities.

The November Amendments modified RCRA in several significant ways, many directed at precluding the disposal of hazardous wastes in land disposal facilities. These modifications by statute are:

- As of May 8, 1985, the disposal of bulk or noncontainerized liquid hazardous wastes in landfills was prohibited
- In conformance with statutorily mandated deadlines, certain specified wastes may not be land disposed unless (1) a finding is made that those wastes may be disposed of in land disposal units with reasonable certainty that such disposal will not lead to migration of hazardous wastes or constituents for as long as the wastes remain hazardous or (2) they can be treated in a way which reduces toxicity and the potential migration of hazardous wastes (time extensions and variances are available)
- Any landfill units or surface impoundment defined as a new unit, replacement unit, or lateral expansion which first received waste after November 8, 1984 must meet new minimum statutory requirements for liner and leachate collection system design.

The overall impact of the above land disposal restrictions will be to reduce the amount of waste that can be disposed of in land disposal units and shift these wastes to treatment facilities; they will also reduce the number of operating land diposal units. The diminished supply of land disposal units and the increased costs associated with transportation to remaining offsite land disposal and treatment facilities can have three potential effects, two intended, one not: (1) force facilities to minimize waste generation; (2) force facilities to adopt innovative destruction techniques; and (3) increase facility incentives to illegally dispose of their wastes and/or increase waste discharges to sewers and/or through direct discharge pipes.

As discussed above, the land disposal ban includes provisions for treatment requirements for certain hazardous wastes subject to the ban. If these wastes are treated to specific levels reducing the toxicity and potential migration of the waste, the waste residue is not subject to the prohibition. This provision, found in 3004(m) of the Act, is a potential mechanism for providing additional pretreatment controls. Section 3004(n), which provides the Agency with the authority to develop regulations for the monitoring and control of air emissions at TSDFs, is another mechanism available under RCRA which could provide for increased control over industrial users.

6.2.2 POTWs Jointly Regulated Under RCRA and CWA

A survey conducted by Association of Metropolitan Sewerage Agencies (AMSA) on whether hazardous wastes are received by their members served as another check of the number of POTWs engaged in hazardous waste handling was reviewed. AMSA represents major metropolitan POTWs and, as such, represents a skewed sample. Nevertheless, nearly all respondents indicated that wastes containing hazardous constituents have been received at their treatment plants. Spills, routine, and illegal discharges were identified as sources of hazardous wastes to the system. In addition, according to the survey, 20 facilities received wastes from liquid hazardous waste haulers. Informal followup discussions with operators of these POTWs indicated that they completed the survey inaccurately and did not, in fact, receive hazardous wastes from haulers. All of these operators indicated that they have not knowingly accepted hazardous wastes. Some of the operators indicated that they sample a subset of haulers on a random basis to ensure that they are not receiving hazardous wastes. On occasion they have turned away haulers and revoked their permits.

6.2.3 Administrative Responsibilities of the State and Federal Government Under RCRA

Unlike the National Pretreatment Program, local governments have no role in hazardous waste management under Subtitle C of RCRA. Therefore, unlike the pretreatment program, the local control authority (i.e., the POTW) receives no notification of hazardous waste activity from industrial users. Rather, this information is either forwarded to the State or EPA. The statutory definition of State responsibilities under RCRA appears in Section 3006.

Congress foresaw that States would receive authorization in a two-stage process: "interim" authorization and final authorization. In the first stage, States with "substantially equivalent" programs to Subtitle C could receive interim authorization. States could receive interim authorization, in two phases, with the second phase divided into three components. Phase I authorization allows for a State program consisting of identification and listing of hazardous waste as well as, generator, transporter, and interim status requirements for TSDFs. Phase II authorization enables the States to administer a TSDF permit program. It is subdivided into three program components corresponding to technical standards for different types of regulated units (storage, incineration, land disposal facilities).

The second stage of the process is termed final authorization. A State need not have achieved interim authorization to receive final authorization. The final authorization stage is more stringent than the interim authorization stage: State programs need be "equivalent" to (or more stringent than) the Federal program to receive final authorization. Indeed, State law need not include a domestic sewage exclusion for industrial users of POTWs, nor do they need to provide permits-by-rule to POTWs. States can regulate POTWs receiving hazardous waste by train, truck, or dedicated pipe as any other facility receiving hazardous waste. See Table 6-3 for the status of State authorization approvals. Note that the table refers to pre-HSWA authorization status. While the HSWA [Section 3006(g)(2)] provides that the States can receive interim and final authorization for the newly added provisions, no State has received either interim or final authorization for the Amendments.

Section 3006(g)(1) provides that the requirements of the HSWA of 1984 take effect in interim and final authorized States at the same time as the requirements take effect in nonauthorized States. In the absence of a State having achieved interim or final authorization for HSWA requirements, the Administrator must carry out the subject requirement. Section 3004(u) requires that any permit issued after November 8, 1984 need address the substantive requirements of the HSWA, e.g., corrective action. What this means is that if a State has yet to receive authorization for a HSWA statutory provision (e.g., corrective action), the State cannot issue a RCRA permit under its own authority. Rather, it can only issue a "partial" permit. The Agency would need to address the remaining portions of the permitting requirements of HSWA for the "partial" permit to be called a RCRA permit.

TABLE 6-3. STATUS OF STATE FINAL AUTHORIZATIONS (STATUS AS OF JANUARY 15, 1986)

STATE	DATE AUTHORIZED FOR PRE-HSWA PROGRAM	DATE TENTATIVE NOTICE PUBLISHED
Arizona	December 4 1985	
Arkansas	January 25 1985	
Colorado	November 2 1984	
Delaware	June 22 1984	
District of Columbia	March 22 1985	
Florida	February 12 1985	
Georgia	August 21 1984	
Guam	January 27 1986	
Illinois		November 19 1985
Indiana		November 19 1985
Kansas	October 17 1985	
Kentucky	January 31 1985	
Louisiana	February 7 1985	
Maryland	February 11 1985	
Massachusetts	February 7 1985	
Minnesota	February 11 1985	
Mississippi	June 27 1984	
Missouri	December 4 1985	
Montana	July 25 1984	
Nebraska	February 7 1985	
Nevada	November 1 1985	
New Hampshire	January 3 1985	
New Jersey	February 21 1985	
New Mexico	January 25 1985	
New York		January 7 1986
North Carolina	December 31 1984	
North Dakota	October 19 1984	
Oklahoma	January 10 1985	
Oregon		December 6 1985
Pennsylvania	January 30 1986	
Rhode Island		December 3 1985
South Carolina	November 22 1985	
South Dakota	November 2 1984	
Tennessee	February 5 1985	
Texas	December 26 1984	
Utah	October 24 1984	
Vermont	January 21 1985	
Virginia	December 18 1984	
Washington		December 6 1985
West Virginia		January 13 1986
Wisconsin		November 27 1985

Consequently, in the case of a POTW with TSDF status, a State cannot issue a NPDES permit with a RCRA permit-by-rule corrective action provision because States have not yet been authorized to permit for corrective action requirements. Therefore, EPA would need to issue a RCRA partial permit for the corrective action portion coincident with the State's issuance of a NPDES permit.

6.2.4 Clean Water Act Controls

The foregoing discussion outlined key RCRA controls on waste generators and TSDFs, and their implications for industrial users and POTWs. As it showed, the Domestic Sewage Exclusion essentially works to relieve IUs from most RCRA requirements if they discharge wastes to sewers, while at the same time, allowing POTWs to receive and treat wastes without assuming the status of a RCRA TSDF. As mentioned earlier, the DSE presumes that Clean Water Act controls will limit the impacts of the discharge of hazardous waste mixed with domestic wastes. This section discusses CWA provisions which might control hazardous discharges.

Although the rationale for the DSE was equally based on construction grant funding and pretreatment, it is apparent that the pretreatment program has the more direct effect on the control of pollutants flowing into POTW system. Consequently, this section concentrates on the pretreatment program's role in controlling DSE discharges. In addition, other CWA provisions affecting wastewater regulation are presented, including POTW permitting under the National Pollutant Discharge Elimination System (NPDES) program, secondary treatment and water quality-based permitting requirements, and municipal sludge regulation.

6.2.4.1 The National Pretreatment Program

The purposes of the National Pretreatment Program are to prevent:

- Interference with POTW operations
- Pass through of pollutants to receiving waters
- Contamination of municipal sludge
- Exposure of workers to chemical hazards.

Under the National Pretreatment Program, these purposes are accomplished by implementing and enforcing the general pretreatment program, including:

- Prohibited discharge standards
- National categorical standards.

Both sets of standards are applicable nationally. All POTWs (approximately 15,000) must enforce specific and general prohibitions against any industry hooked to their system. All categorical industries must comply with categorical standards even if they discharge to a POTW that does not have a Federally approved local pretreatment program. In addition, POTWs are required to develop local limits to prevent pass through, interference, and sludge contamination.

The General Pretreatment Regulations (40 CFR 403) also require the development of Federally approved local pretreatment programs by the following classes of POTWs:

(1) POTWs with a total design flow greater than five million gallons per day (mgd) and accepting IU pollutants subject to pretreatment standards

(2) As determined by the Regional Administrator or State director, any POTW with design flow less than five mgd accepting significant types and quantities by industrial wastes or experiencing treatment process upsets, NPDES permit violations or sludge contamination.

As stated earlier, approximately 1500 POTWs are required to develop approved pretreatment programs. These POTWs have a total flow of almost 20 billion gallons per day, which constitutes almost 74 percent of total POTW flow nationally. In addition, based on conservative NEEDS estimates, pretreatment POTWs receive 82 percent of the National industrial flow.

The rationale behind the DSE was that by imposing categorical standards, general specific prohibitions, and local limits through the pretreatment program, human health and the environment would be protected from hazardous wastewaters. The following section explains some of the ways in which pretreatment programs achieve these purposes.

General Prohibitions

Section 403.5(a) establishes a general prohibition against the introduction of pollutants into a POTW by a nondomestic source that passes through or interferes with the operation or performance of the POTW. General prohibitions apply to all industrial users regardless of whether the source is subject to other National pretreatment standards (see the discussion below under Categorical Standards) or Federal, State, or local pretreatment requirements.

Interference

An industrial user may not discharge substances in volumes or concentrations that result in "interference" to POTW operations or the environmental benefits of those operations. Proposed §403.3(i), 50 FR 25526, June 19, 1985, defines "interference" as "a discharge by an industrial user which, alone or in conjunction with discharges by other sources, inhibits or disrupts the POTW, its treatment processes or operations, or its sludge process, use or disposal, and which is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal by the POTW in accordance with §405 CWA; RCRA, including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA; the Toxic Substances Control Act; the Marine Protection, Research and Sanctuaries Act; or more stringent State or local regulations."

Pass Through

An industrial user may not discharge substances in volumes or concentrations that "pass through" the POTW system. Proposed §403.3(n), 50 FR 25526, June 19, 1985, defines "pass through" as the discharge of pollutants through the POTW into navigable waters in quantities or concentrations that, alone or in conjunction with discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Specific Prohibitions

Section 403.5(b) establishes specific prohibitions against the introduction of pollutants into a POTW that will cause (1) a fire or explosion hazard in the POTW; (2) corrosive structural damage to the POTW (but in no case are discharges with pH lower than 5.0 allowed, unless the works is specifically designed to accommodate such discharges); (3) interference by solid or viscous pollutants that obstruct the flow in the POTW; (4) interference by the flow rate and/or pollutant concentration of any pollutant, including oxygen demanding pollutants (BOD, etc.); and (5) interference due to heat in amounts that inhibit biological activity in the POTW, but in no case can heat cause the temperature at the POTW treatment plant to exceed 40 degrees C (104 degrees F) unless the approval authority, upon request of the POTW, approves alternative temperature limits. The first two prohibitions parallel characteristics under RCRA that make a solid waste a hazardous waste.

When Specific Limits Must Be Developed By POTW

Section 403.5(c) requires POTWs developing a pretreatment program to develop and enforce specific limits to implement the general and specific prohibitions. All other POTWs are required [in cases where pollutants contributed by user(s) result in interference or pass through and such violation is likely to recur] to develop and enforce specific effluent limits for industrial user(s), and all other users, as appropriate, which, together with appropriate changes in the POTW treatment plant's facilities or operation, are necessary to ensure renewed and continued compliance with the POTW's NPDES permit and sludge use or disposal practices.

Section 403.5(d) provides that specific prohibitions or limits on pollutants or pollutant parameters developed by POTWs are deemed pretreatment standards for the purposes of Section 307(b) of the Act. Therefore, the specific prohibitions are federally enforceable.

Categorical Standards

Industrial users must comply with applicable National categorical standards as well as local regulations imposed by the POTW. Each categorical pretreatment standard is a separate regulation developed in EPA's effluent guidelines process and contains limitations for pollutants commonly discharged by the specific industrial category. All firms regulated by a particular category are subject to these standards, no matter where they are located. Responsibilities of categorical industries include:

- Complying with specific technology-based effluent limitations for pollutants of concern, which may involve designing, purchasing, and installing end-of-pipe pretreatment equipment or process changes
- Operating and maintaining the installed technology properly to achieve consistent compliance with standards
- Monitoring discharges to determine compliance with standards according to frequencies established by Federal or local rules
- Reporting regularly to the control authority their compliance status or progress towards compliance, as well as any unusual or emergency conditions (several types of reports are required by 40 CFR 403.12).

These categorical standards are being developed by the Agency as required by Section 307 of the CWA and the 1976 NRDC v. Train consent decree. Although 34 industries were defined as "categorical" for which pretreatment standards were to be defined, the Agency has narrowed that list to 23 specific industrial categories. The reduction to 23 categorical industries is a result of several circumstances: 12 categories have been exempted; two industrial categories -- organic chemicals, and plastic and synthetic fibers -- were combined; the mechanical products category was incorporated into metal finishing; and a new category, nonferrous metal forming, was added. See Table 6-6 for a listing of proposed and promulgated categorical standards.

The Agency targeted its review on these industries and on the 126 toxic priority pollutants. As can be seen from Table 3-13, the Agency concentrated its efforts on regulating the discharge of toxic metals. However, the Agency has the authority to additionally regulate, and it has on occasion regulated, pollutants other than the 126 toxics.

6.2.5 Responsibilities at the Local, State, and Federal Level

The Pretreatment Regulations use the terms "Control Authority" and "Approval Authority" to refer to the powers and responsibilities of each governmental level. The Control Authority has the responsibility to ensure that industrial users of the POTW system achieve and maintain compliance with pretreatment standards and requirements. The Approval Authority is responsible for overseeing the development and implementation of local pretreatment programs. When a local program is approved, the POTW becomes the Control Authority. If the POTW does not have an approved program, the Approval Authority, either the State or EPA, acts as the Control Authority. The State becomes the Approval Authority only if it has an approved State pretreatment program pursuant to §402(b) of the CWA. Otherwise, EPA Regions function as the Approval Authority.

The POTW, as the Control Authority, has responsibility for developing, implementing, and enforcing a local pretreatment program. This program must provide the POTW with the authority and procedures to do the following:

- Conduct an industrial waste survey (IWS) to identify significant industrial users and to update this IWS periodically
- Apply and enforce the requirements of the Federal categorical pretreatment standards, the General Pretreatment Regulations, and any other State or local regulations used to control nondomestic discharges
- Establish local effluent limits to protect the operation of its treatment plant, the quality of the receiving water, and the quality of its sludge
- Monitor its industrial users to determine compliance and noncompliance with Federal and local limits and standards
- Require industrial users to submit Baseline Monitoring Reports, Compliance Reports, and other reports as required by Section 40 CFR 403.12 of the General Pretreatment Regulations
- Prepare and submit any information that may be required by the Approval Authority to support the POTW's program implementation activities (e.g., annual reports).

As noted above, the National Pretreatment Program is designed for States to act as the Approval Authority. Approval Authority responsibilities include:

- Reviewing and approving local pretreatment programs
- Investigating noncompliance and performing audits of local pretreatment programs to determine whether POTW activities and procedures conform to program and permit requirements
- Ensuring that Control Authorities are adequately enforcing pretreatment standards and requirements.

To gain Approval Authority from EPA, a State must develop a pretreatment program that shows that it has the necessary authority, resources, and procedures to carry out the responsibilities outlined above. States may also design a program under which the State is the Control Authority and no POTWs are required to develop programs. In these cases, all development, implementation, and enforcement activities are conducted by the State, and there is no need for local program review and approval. Connecticut, Vermont, Alabama, Mississippi, New Jersey, and Nebraska have assumed either partial or total responsibility for running local pretreatment programs in their States. Table 6-4 provides a list of approved NPDES and Pretreatment States.

Federal pretreatment program responsibilities are divided between the ten EPA Regions and EPA Headquarters. Headquarters provides the National overview, direction, and oversight of the program while delegating most of the administrative and programmatic functions related to enforcement to the Regional offices.

EPA's Regional Offices are responsible for developing, implementing, and overseeing State and local pretreatment programs. For those States with approved pretreatment programs, the Regions provide general guidance, direction, and enforcement assistance. They are responsible for the overview and evaluation of State programs, ensuring that they carry out all their delegated responsibilities. However, where States have not been delegated Approval Authority responsibilities the Region must take on these responsibilities as

TABLE 6-4. STATE NPDES PROGRAM STATUS AS OF JUNE 1985

	Approved State NPDES Permit Program	Approved to Regulate Federal Facilities	Approved State Pretreatment Program
Alabama	10-19-79	10-19-79	10-19-79
California	05-14-73	05-05-78	
Colorado	03-27-75		
Connecticut	09-26-73		06-03-81
Delaware	04-01-74		
Georgia	06-28-74	12-08-80	03-12-81
Hawaii	11-28-74	06-01-79	08-12-83
Illinois	10-23-77	09-20-79	
Indiana	01-01-75	12-09-78	
Iowa	08-10-78	08-10-78	06-03-81
Kansas	06-28-74		
Kentucky	09-30-83	09-30-83	09-30-83
Maryland	09-05-74		
Michigan	10-17-73	12-09-78	04-16-85
Minnesota	06-30-74	12-09-78	07-16-79
Mississippi	05-01-74	01-28-83	05-13-82
Missouri	10-30-74	06-26-79	06-03-81
Montana	06-10-74	06-23-81	
Nebraska	06-12-74	11-02-79	09-07-84
Nevada	09-19-75	08-31-78	
New Jersey	04-13-82	04-13-82	04-13-83
New York	10-28-75	06-13-80	
North Carolina	10-19-75		06-14-82
North Dakota	06-13-75		
Ohio	03-11-74	01-26-83	07-27-83
Oregon	09-26-73	03-02-79	03-12-81
Pennsylvania	06-30-76	06-30-78	
Rhode Island	09-17-84	09-17-84	09-17-84
South Carolina	06-10-75	09-26-80	04-09-82
Tennessee	12-28-77		08-10-83
Vermont	03-11-74		03-16-82
Virgin Islands	06-30-74		
Virginia	03-31-75	02-09-82	
Washington	11-14-73		
West Virginia	05-10-82	05-10-82	05-10-82
Wisconsin	02-04-74	11-26-79	12-24-80
Wyoming	01-20-75	05-18-81	

well. The Regions are also responsible for the identification and resolution of problems that impede the implementation and administration of the pretreatment program.

6.2.6 Other CWA Requirements Affecting Control of DSS Wastes

As indicated above, several other CWA provisions play a part in establishing the fundamental goals that POTWs must meet in implementing pretreatment requirements and treating wastewater. NPDES permit limits and sludge management practices are specifically protected by the general prohibitions against pass-through and interference. Thus, specific POTW effluent limits and sludge disposal guidelines clearly will influence the extent to which POTWs allow wastes containing hazardous constituents to be discharged to their systems.

6.2.6.1 Municipal Permitting

As with other point sources, wastewater discharge controls are imposed on municipalities under the NPDES program established in §402 of the Clean Water Act. Under this permitting program, POTWs, which discharge directly into surface waters, must apply for a NPDES permit. EPA or State permit writers evaluate the volume and quality of municipal effluent, the pollution control technology currently being employed, the applicability of National technology-based standards, and receiving water quality to develop pollutant-specific numerical effluent limits and removal requirements for the POTW's NPDES permit. NPDES permits have a five-year duration and may incorporate other conditions including development and operation of a pretreatment program, submission of self-monitoring reports (discharge monitoring reports), and compliance with interim compliance schedules. Municipalities with NPDES permits are subject to both technology-based and water quality-based requirements.

6.2.6.2 Technology-Based Treatment (Secondary Treatment)/Construction Grants

Regulation of municipal sewage treatment plants, pursuant to §201 of the Clean Water Act, initially emphasized the control of conventional pollutants. The Act required POTWs to meet limitations based on secondary treatment by

1977. This deadline has since been extended for some POTWs. The construction grants program was initiated to provide funding for POTWs that needed to improve or build new treatment works to meet the requirements of the CWA. To date, $40 billion has been expended in Federal assistance to sewage treatment plants for construction, and approximately 3,400 sewage treatment plants have been assisted.

Secondary treatment has been defined in terms of biochemical oxygen demand, suspended solids, and pH control. POTWs are not usually required to install specific technology to control toxic pollutants, although incidental removal in secondary treatment may be quite high for some toxic pollutants. Instead, the CWA envisions that, by implementation of pretreatment programs and industrial compliance with categorical standards, toxic pollutants in municipal effluents will be adequately controlled. In addition, POTWs are subject to limits for toxic and other pollutants in NPDES permits, based on water quality considerations.

6.2.6.3 Water Quality-Based Permitting

Water quality-based standards are employed to supplement technology-based controls on municipal dischargers to meet water quality objectives. Under CWA Section 303, water quality standards are developed by States, based either on Federal water quality criteria or locally derived criteria, to address certain water quality parameters for specific receiving water bodies. To establish water quality standards, States designate desired uses for stream segments, such as fishing, swimming, water supply, or industrial use. The most sensitive use for each stream is protected by a set of ambient standards for various pollutants, which then become the operative water quality standards. Such water quality-based pollutant standards, in turn, are to be translated into effluent limits needed to protect water quality and designated uses pursuant to Sections 301 and 302 of the CWA, using wasteload allocation techniques. Thirty-eight percent of total POTW flow nationally is treated more stringently than required by technology-based standards. The majority of the POTWs subject to the more stringent limits are required to remove additional amounts of conventional and nonconventional pollutants (e.g., ammonia, phosphorus).

Extension of the water quality-based approach to cover toxic pollutants has been hindered by the absence of water quality criteria or State standards for toxic pollutants. In fact, as was seen in Table 5-3, very few water quality criteria exist for hazardous constituents being studied in the DSS. Moreover, not all potentially toxic materials can be identified by chemical methods, nor can interactive effects among pollutants always be positively identified.

Recognizing this, EPA published a Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants in 49 FR 9017. The Policy discusses the use of an "integrated strategy" of both biological and chemical testing "... to address toxic and nonconventional pollutants from industrial and municipal sources." In the absence of numeric water quality criteria and standards, the Agency advises that "... it is more feasible to examine the whole effluent toxicity and instream impacts using biological methods rather than attempt to identify all toxic pollutants, determine the effects of each pollutant individually, and then attempt to assess their collective effect." NPDES permittees may also be required to conduct a toxicity reduction evaluation (TRE) to determine control options for toxic control. TREs will be used within industrial or municipal systems to isolate sources of toxicity and define control options. The Policy directs special attention to POTWs that have a "significant contribution of industrial wastewater," and goes on to say that POTWs are often significant sources of toxic materials. The ultimate purpose of this effort is to design controls to meet water quality standards. Therefore, POTWs with significant contributions of industrial wastewater, including those that receive DSE wastewaters, should be taking a harder look at setting local limits and more stringent prohibitions.(6)

In addition, the Agency's water program recently conducted a study of the use that EPA Regions and States are making of effluent bioassays in identifying water quality-limited bodies, setting controls, and assessing compliance.(7) That study showed that 39 States are now using bioassays for these purposes and a few States are conducting a substantial amount of bioassay work for the purpose of developing limits. In addition, eight of

EPA's ten Regional offices are now using bioassays at some level to set effluent controls. In light of these developments, POTWs and therefore IUs may expect increased toxics regulation of wastewater discharges.

6.2.6.4 Regulation of Municipal Sludge Disposal

Section 405 of CWA requires development of regulations providing guidelines for the use and disposal of municipal sludge. Such regulations must identify sludge use and disposal options, specify factors to be taken into account in determining the practices applicable to each option, and identify concentrations of pollutants that interfere with each option. To date, regulations defining acceptable land disposal practices (40 CFR 257) have been promulgated under the joint authority of CWA and Subtitle D of RCRA. Other laws that govern municipal sludge use or disposal depend on the option employed or the constituent present in the sludge. These include the Clean Air Act (CAA), the Marine Protection, Research, and Sanctuaries Act (MPRSA), RCRA Subtitle C, and the Toxic Substances Control Act (TSCA). Use and disposal of industrial wastewater treatment sludge is not subject to regulation under CWA Section 405. Like municipal sludge, however, certain aspects of industrial sludge use and disposal are governed by CAA, MPRSA, RCRA Subtitles C and D, and TSCA.

Until recently, control of municipal sewage sludge management practices has gone forward on a media-specific basis and has been controlled inconsistently by States. POTW operators rarely had access to comprehensive sludge criteria to guide local limits decisions in their pretreatment programs. To alleviate this gap, EPA is currently developing comprehensive sludge management regulations under authority Section 405 of CWA.

The Agency is developing regulations governing municipal sludge management in two parts: (1) a programmatic component (40 CFR 501 and 502), which delineates the roles of the Federal and State governments and sets forth minimum criteria for State sludge management programs; and (2) a technical component (40 CFR 503), which sets forth numerical limits on sludges disposed of by different practices (i.e., distribution and marketing, ocean dumping, landfilling, land application, incineration), as well as best management practices, treatment requirements, and monitoring and sampling protocols.

As a first step in producing the technical regulations, the Agency developed a list of pollutants for regulatory consideration. Twenty-six of the pollutants currently being evaluated for sludge regulation are considered hazardous (i.e., Tier 1 or Tier 2 pollutants, as defined in this report). Therefore, for those 26 pollutants, the promulgation of technical regulations in 1987 could establish new standards for the control of hazardous waste discharges to POTWs.

6.2.6.5 Summary of CWA Controls Applicable to DSS Wastes

In essence, the CWA imposes a double net to control the environmental, health, and plant impacts of industrial wastewater discharged to the sewers. First, industries are subject to a range of standards -- categorical standards, general and specific prohibitions, and local limits -- to guarantee that the receiving POTW and environment are protected. Authorized industrial discharges are then incidentally and intentionally treated at the sewage treatment plant to a level dictated by controls placed on the POTW itself to ensure that POTW releases do not harm the environment (i.e., surface water and media affected by sludge disposal). This process is intended to be iterative where necessary. If any POTW cannot meet environmental objectives due to industrial discharges, it must adjust its pretreatment controls to remediate problems.

Thus, the CWA provides mechanisms for the site-specific and ongoing evaluation of the acceptability of DSS loadings to POTWs and the environment. Treatment requirements imposed on industrial users discharging hazardous constituents may be both technology-based and responsive to ambient environmental conditions. Administratively, DSS dischargers may be subject to monitoring, reporting, permitting, and compliance obligations under the CWA and its pretreatment requirements.

6.2.7 Other Statutory Controls Affecting the Discharge of Hazardous Wastes to Sewers

Several other statutes may either directly or indirectly affect an industry's ability to discharge hazardous wastes mixed with sewage to POTWs. Principal among these are the Occupational Safety and Health Act, the Clean

Air Act, and the Comprehensive Emergency Response, Compensation, and Liability Act. These are discussed below.

6.2.7.1 OSHA/Worker Safety

Many of the hazardous pollutants in DSE wastes that are the subject of this study are readily volatilized. Once volatilized, these pollutants may pose a health risk to POTW workers through inhalation. This section examines the extent of protection from workplace risks afforded to POTW workers by the Federal Occupational Safety and Health Act (OSHA, 29 USC §650 et seq).

OSHA authorized the Secretary of Labor to establish health and safety standards and procedures applicable to employers and their employees engaged in interstate commerce. By definition, though, "employer" does not include "the United States or any State or political subdivision of a State" [Section 3(5) of OSHA]. Consequently, OSHA standards do not cover POTW workers since they are typically employees of a State or a political subdivision of a State, e.g., employees of municipalities or special districts.

Nevertheless, Section 18 of OSHA potentially provides some measure of protection for State and local workers in an indirect way. States may submit plans for assuming responsibility for developing and enforcing occupational safety and health standards relating to safety and health issues for which a Federal standard has been promulgated under Section 6 of OSHA. The Secretary of Labor, under Section 18 of OSHA, shall approve a State plan if, inter alia, that plan "contains satisfactory assurances that such State will, to the extent permitted by its laws, establish and maintain an effective and comprehensive occupational safety and health program applicable to all employees of public agencies of the State and its political subdivisions, which program is as effective as the standards contained in an approved plan." Therefore, where approved State plans exist, POTW workers are protected to the same extent as private employees.

Currently, 26 States and territories have approved plans. Since the remaining 30 States and territories have no plans, POTW workers are not afforded protection under the auspices of OSHA. However, some States are contemplating developing their own plan of protection whether or not Federal approval under OSHA is sought.

For POTW workers in States that have approved plans, some measure of protection from exposure to toxic pollutants is afforded. These States must develop and enforce, as part of their approved plan, the exposure standards contained in the regulations at 29 CFR 1910.1000 to 1910.1046. Specifically, 29 CFR 1910.1000, contains a list of compounds that have maximum exposure levels during the workday. Many of the compounds on the list are also compounds that are part of this study (e.g., acetone).

Notwithstanding the existence of these ambient standards, protection may be afforded workers through use of equipment (e.g., respirators), that effectively reduces the exposure level instead of eliminating the source of the compound. Nevertheless, a POTW might be able to utilize these standards to support a local limit on the discharging industrial user. However, a State can only enforce against the POTW for allowing a worker to be exposed to the compound. In summary, the basic source of worker protection falls to the POTW itself, for only the POTW has the knowledge and authority to clearly control the discharge of the pollutant.

6.2.7.2 Air Pollution Control

A significant number of the hazardous pollutants found to be discharged to sewers are volatile organic compounds (e.g., spent solvents, degreasers that exhibit a high degree of volatility). These pollutants often volatilize prior to or at the treatment plant. The compounds volatilize into the atmosphere through manholes, lift stations, headworks, primary clarifiers, aeration basins, and trickling filters. As noted above, when these hazardous pollutants are permitted to concentrate in enclosed spaces, they present a potential risk to POTW workers. Moreover, their release to the atmosphere may create or exacerabate air pollution problems. Consequently, controlling the entry of these pollutants into sewers is not only driven by concerns over their presence in the water, but also their potential release to the atmosphere. The following subsections describe the potential mechanisms for controlling air emissions under the Clean Air Act, Resource Conservation and Recovery Act, and Clean Water Act.

The Clean Air Act

Ambient Air Standards and State Implementation Plans

The Clean Air Act (CAA) establishes a multifaceted approach to air pollution control that involves a combination of Federal and State controls. At the Federal level, the Administrator of EPA lists, pursuant to Section 108 of the CAA, each air pollutant the emission of which causes or contributes to air pollution which may reasonably be anticipated to endanger public health and welfare and the presence of which in the ambient air results from numerous or diverse mobile or stationary sources. For these pollutants, known as criteria pollutants, the Administrator then develops air quality criteria documents that include amounts, sources, adverse effects, and information on such other air pollutants that, when present in the atmosphere, may interact to produce an adverse effect on public health or welfare.

Based on these criteria, EPA then develops National Ambient Air Quality Standards that each State is responsible for attaining and maintaining within its boundaries. Currently, ambient air quality standards exist for six air pollutants: oxides of sulfur (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO), lead (Pb), ozone (O_3), and total suspended particulates (TSP). Once ambient air quality standards are established, States are required under Section 110 to develop plans [State implementation plans (SIPs)] for implementing air pollution control standards for existing sources that will result in the attainment and maintenance of ambient air quality standards. New sources are required to comply with new source performance standards (NSPS) promulgated by EPA, provided the source is within one of the industrial categories. Otherwise, the State standards for similar existing sources are applied.

None of the ambient standards directly addresses volatile organic compounds (VOCs). However, ozone is generally produced from the oxidation or reduction of VOCs, and ozone is partially controlled by reducing VOC emissions to the atmosphere. Since many of the hazardous pollutants discharged to the sewers are volatile organic compounds, regulating the entry of these organic compounds to sewers and POTWs would assist in attaining or maintaining compliance with the ambient ozone standards. To date, EPA has not addressed the release of volatile organic compounds from sewers and POTWs. However, it is a subject that is being investigated by EPA. The results of the DSS further support the effort to understand the magnitude of the VOC problem.

National Emission Standards for Hazardous Air Pollutants (NESHAPs)

The other primary mechanism for controlling air pollutants involves the establishment of emission standards for specific pollutants on a National basis. These National Emission Standards for Hazardous Air Pollutants (NESHAPs), promulgated under authority of Section 112 of the CAA, apply to all sources whether existing or new. EPA may establish a NESHAP for an air pollutant for which there is no applicable ambient air quality standard and which causes or contributes to air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.

EPA has promulgated NESHAPs for beryllium, beryllium rocket motor firing, mercury, vinyl chloride, radionuclides, equipment leaks of benzene, and asbestos. NESHAPs can also be established for equipment leaks of other volatile hazardous air pollutants (VHAPs); however, the only VHAP thus far set for equipment applies to leaks of benzene from pumps, valves, and compressors. Therefore, except for benzene and vinyl chloride, NESHAPs have a limited effect on controlling the environmental release of hazardous pollutants under investigation in this study. NESHAPs are under consideration for pollutants such as carbon tetrachloride, 1,3-butadiene, chromium, cadmium, and ethylene dichloride. A complete listing is provided in Table 5-10. Standards for these substances might have a more direct effect on DSS wastes.

Either the ambient air standards or NESHAPs regulatory mechanisms could be used to control air releases of hazardous pollutants if EPA sought to do so. However, control is complicated by the manner of release (e.g., manholes, headworks, clarifiers), because they are not the typical point source that the Agency has previously regulated. In fact, POTWs as air sources have greater similarity to area sources. The CAA does provide for imposition of management practices that could be employed to keep the volatile materials out of the system before they can pose a problem.

The Resource Conservation and Recovery Act

As mentioned earlier, RCRA regulates hazardous waste management as it affects the environmental media. Prior to the passage of the amendments, certain RCRA regulatory requirements did offer air emissions control. For example, the interim status closure and post closure regulations for landfills required the owner/operator to maintain and monitor a gas collection and control system to control the escape of gases [40 CFR 265.310 (d)(3)]. With the passage of the Amendments, however, the RCRA program has achieved additional authority to control air emissions. Those authorities are described briefly below.

Section 3004(n) of RCRA, newly added by HSWA of 1984, imposed a 30-month deadline to promulgate regulations for the monitoring and control of air emissions at TSDFs. Section 3004(m) of RCRA, which authorizes the Agency to promulgate treatment standards for wastes subject to the land disposal ban, provides another mechanism for hazardous waste air emissions control. It requires that standards be promulgated which "...substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment be minimized." A third RCRA provision with the potential for air emission control appears in Section 3005(c). It enables the Agency to add terms to permit conditions as determined necessary to protect human health and the environment, beyond those conditions specifically required by the regulations. This provision would enable the Agency to tailor permit conditions to include air emission controls as necessary on a site-specific basis. Section 3004(u) and 3008(h) authorize the Agency to take corrective action to address air emissions, among releases to other environmental media, at RCRA permitted and interim status facilities, respectively. In addition, in appropriate cases, the Agency may address air emission problems using §7003 where those problems may present an imminent and substantial endangerment of human health or the environment.

Clean Water Act

Water regulations, including categorical standards, local limits, and general prohibitions, may dictate that source controls be employed by industrial users not only to reduce wastewater concentrations but to prevent volatilization. In fact, the CWA specifically identified "nonwater quality objectives" as a basis for industrial wastewater regulation. In two recent Federal Register notices, the Agency has indicated its intention to control the volatilization of organic pollutants from wastewater treatment systems in the organic chemicals, plastics, and synthetics fibers industries using the industrial effluent control authorities of the Clean Water Act.

6.2.7.3 Releases Under CERCLA

Sections 103(a) and (b) of CERCLA require persons in charge of facilities from which hazardous substances have been released, in quantities that are equal to or greater than the reportable quantities, to notify the National Response Center (NRC) of the release. [40 CFR Part 302]. These notification provisions may apply, in certain instances, to wastewater discharges by industries to POTWs and to POTW releases of waste constituents to surface waters, sludge, air, and ground water. Section 103(a) and (b) notification provisions do not apply, however, to Federally permitted releases as defined in Section 101 of CERCLA. Section 101(10)(J) of CERCLA defines Federally permitted release to include the introduction of pollutants into POTWs if the pollutant is subject to and in compliance with pollutant-specific categorical standards and the generic prohibitions and the pollutant is specified in and in compliance with enforceable requirements in a pretreatment program submitted for EPA approval by a State or local government. However, categorical standards have only been set for a subset of industries. Thus, all other industrial categories, as well as plants not in compliance with categorical pretreatment requirements, would need to notify the NRC if releases exceeded reportable quantities.

Additional provisions under CERCLA Section 101 define Federally permitted releases to include discharges in compliance with a NPDES permit, discharges resulting from circumstances identified, reviewed, and made part of the public record during NPDES permit issuance, and continuous or anticipated intermittent discharges identified in a NPDES permit or application, which are caused by events within the scope of relevant operating or treatment systems. These provisions would operate to exempt certain POTW releases to surface waters, but would not similarly extend to releases to sludge, air, and ground water. The Agency has not yet proposed rules defining "federally permitted releases."

Dischargers to a POTW from a mobile source (e.g., liquid waste haulers) need not report to the National Response Center if they have contracted with, or otherwise received written permission from, the POTW operator to discharge the waste, and meet the requirements discussed above for discharges to sewers. Thus, the mobile source exemption parallels the permit-by-rule provisions of RCRA.

Section 103(f) of CERCLA provides an alternative reporting mechanism for releases which must be reported under RCRA Subtitle C and for releases considered "continuous" or "stable in quantity and rate." Notification for such releases is to be provided annually, and at such time as there is a statistically significant increase in discharge quantity. Rules on defining "continuous" have not been promulgated, but options being considered include definitions that would exempt: (1) releases continuous during operating hours; and (2) releases which are continuous during regularly-occurring batch processes.

Other key CERCLA provisions may also apply to POTW releases. CERCLA Section 107 establishes liability for any costs for removal or remedial action and for any damage to natural resources caused by a release or threatened release of a hazardous substance from a facility. This provision may, in some instances, apply to POTW releases of waste constituents to surface waters, sludge, air, and ground water.

6.2.7.4 EPA's Ground Water Strategy

The problem of ground water contamination has only recently been recognized. EPA issued a ground water protection strategy in 1984 to coordinate the protection of ground water through existing statutes (RCRA, CERCLA, CWA, SDWA, TSCA, and FIFRA), because no single Federal law provides comprehensive ground water protection. This strategy sets forth EPA's intentions to:

- Strengthen State ground water programs
- Cope with unaddressed ground water problems
- Establish a framework for decisionmaking within EPA programs
- Strengthen EPA's internal ground water organization.

Although the strategy presents an aquifer classification scheme to guide Federal decisionmaking, it does not directly address EPA's methods for dealing with any specific ground water problems, including those potentially arising from POTWs. A recent survey of State policies and problems, conducted by EPA's Office of Ground Water Protection, also did not indicate that any States had recognized problems with POTWs or had developed policies to deal with them.

6.3 EVALUATION OF THE EFFECTIVENESS OF THE PRETREATMENT PROGRAM IN CONTROLLING DSS WASTES

This section reports the implementation status of the pretreatment controls and provides judgement as to what extent Federal, State, and local pretreatment measures have been effective in limiting impacts from DSS wastes. This analysis is subdivided into the key pretreatment areas affecting DSS waste controls. First, a status report on implementation milestones is provided, covering program approvals, audit results, and compliance data. Then, effectiveness analyses are performed on principal pretreatment control mechanisms including categorical standards, specific prohibitions, local limits, and municipal spill and waste hauler controls. Finally, this section examines municipal perceptions on the need for hazardous waste control at POTWs.

A variety of data sources were employed to perform this evaluation. Major assistance was provided by the Association of Metropolitan Sewerage Agencies (AMSA), which circulated a survey on hazardous wastes to its membership. Responses were then provided to EPA. (A summary of the survey results, along with the survey instrument are provided in Appendix K.) The survey was sent to 107 AMSA members, and responses were received from 66, a 62 percent response rate. In aggregate, the respondents have responsibility for 308 treatment plants, accounting for 39 percent of total POTW flow nationwide and an estimated 47 percent of National industrial flow. It is unlikely that the AMSA respondents are representative of all POTWs or even all pretreatment POTWs, since they tend to be large, sophisticated metropolitan agencies. Nonetheless, since they are located in major urban areas and they receive such significant loadings of industrial wastes, it is likely that they have extensive experience with hazardous waste discharges.

A second evaluative data source used was a report, prepared for EPA in April 1985, which summarizes audits that had been performed on pretreatment programs at 28 municipalities.(8) EPA performs audits on pretreatment programs that have been approved for at least one year to determine pretreatment program effectiveness, POTW compliance, and program areas warranting more EPA technical assistance. Approximately 60 audits have been performed to date. These audits are resource-intensive efforts, involving considerable onsite inspection and review. They provide extremely detailed observations of the success of pretreatment. While the audits focused on toxics control generally, they should provide insight into POTW's ability to control DSS wastes as well. The audits covered were conducted in EPA Regions I, III, IV, VII, VIII, and X, providing geographic diversity, and evaluated ranging POTWs in size from 0.6 MGD to 402 MGD.

Finally, extensive programmatic data from EPA was drawn upon -- from the Office of Water Enforcement and Permits, EPA Regions, and the Industrial Technology Division of the Office of Water Regulations and Standards.

6.3.1 Status of Pretreatment Program Implementation

EPA first issued the General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403) on June 26, 1978. These regulations were challenged by various parties. EPA entered into a settlement agreement to propose and take final action on certain amendments to the 1978 regulations. After a public comment period, followed by additional regulatory development activities, the proposed amendments to the regulations were promulgated on January 28, 1981, with an effective date of March 30, 1981. On March 27, 1981, EPA indefinitely postponed the effective date of certain portions of the amendments in order to allow the Agency to conduct a Regulatory Impact Analysis (RIA) as required by Executive Order 12291. On January 31, 1982, EPA reinstated the effectiveness of all but four of these amendments.

In July 1982, the U.S. Court of Appeals for the Third Circuit ruled on a suit brought by the Natural Resources Defense Council (NRDC), which asserted that EPA's postponement of the Regulations violated the Administrative Procedures Act. The Court directed EPA to reinstate, all of the amendments to the General Pretreatment Regulations effective March 30, 1981. Various parties continued to challenge the pretreatment regulations and the electroplating categorical pretreatment standards. The pretreatment provisions challenged were:

- The definitions of "new source," "interference," and "pass through"
- The combined wastestream formula
- The removal credits provisions
- The fundamentally different factors (FDF) variance provision.

In a decision of the U.S. Court of Appeals for the Third Circuit in September 1983, the Court ordered EPA to redefine pass through, interference, and new source. The Court also upheld the electroplating standards, the combined wastestream formula, and the removal credits provision. Subsequently in 1985, the Supreme Court upheld EPA's fundamentally different factors variance. Since 1981, EPA has promulgated amendments to the removal credits regulations. These amendments are currently being challenged in the Third Circuit.

Program Approvals

As a result of these various delays, the development and implementation of the National Pretreatment Program was hampered, and only about 40 percent of approximately 1,500 POTWs required to develop pretreatment programs had their programs approved by the July 1, 1983 deadline. Substantial progress has been made since major program questions have been resolved. Figure 6-5 illustrates the total number of local program approvals for the Fiscal Years 1982-1984 and projected Fiscal Year 1985. Table 6-5 breaks out program approvals by EPA Region as of June 1985.

In terms of State pretreatment programs, 21 States currently have received program approval out of the 37 NPDES States eligible to apply for approval authority. Table 6-4 lists these States and the dates of their program approval. In sum, after a slow start, a majority of States and POTWs have approved programs.

Program Audits

To ascertain if pretreatment programs are being effectively operated after approval, EPA officials, with contractor assistance, have conducted audits at numerous municipalities. Audit teams interviewed POTW officials involved in the pretreatment program, accompanied sampling crews to observe field and laboratory procedures, and reviewed files and budget data. The audit teams evaluated the following:

1) Adequacy of the municipal sewer use ordinance
2) Existence of interjurisdictional agreements for POTWs receiving wastes from more than one jurisdiction
3) Implementation of an industrial user permit system or other effective control mechanism
4) Existence of adequate enforcement policies and procedures and a willingness to take enforcement actions when necessary
5) Annual publication of significant violations in a local newspaper
6) Adoption and enforcement of the prohibited discharge standards in 40 CFR 403.5 for conventional pollutants, heat, pH, and flow in the local ordinance
7) Enforcement of National categorical standards, including appropriate application of the combined wastestream formula and institution of industrial user reporting requirements
8) Implementation of local limits that have been derived from a technical evaluation of POTW process inhibition levels, water quality standards, and sludge disposal options

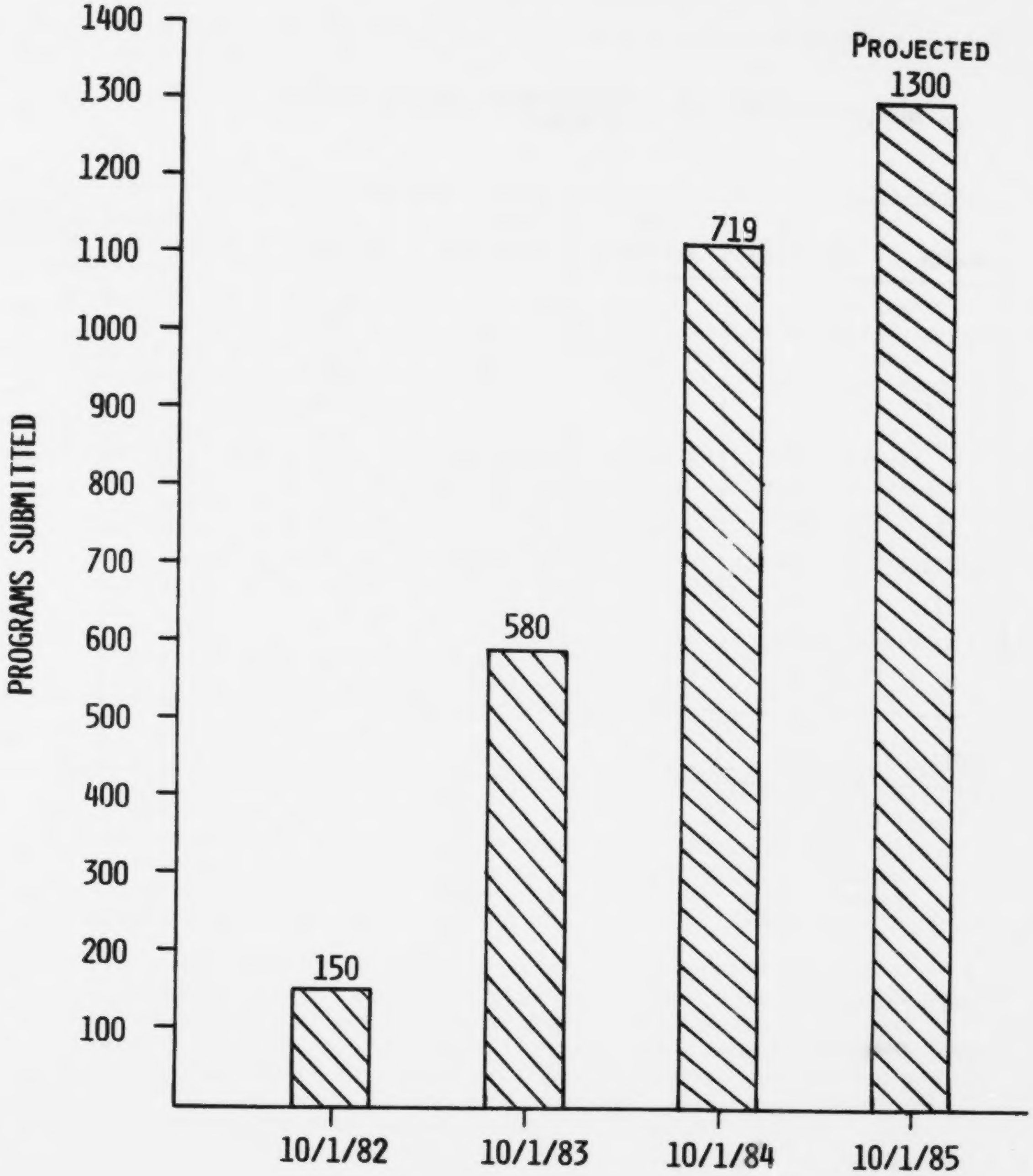

FIGURE 6-5. LOCAL PRETREATMENT PROGRAM APPROVALS IN FY 82, 83, 84, AND 85

TABLE 6-5. PRETREATMENT PROGRAM APPROVAL STATUS (6/30/85)

REGION	EPA REQUIRED	EPA APPROVED	STATE REQUIRED	STATE APPROVED	TOTAL REQUIRED	TOTAL APPROVED
I	68	45	13	10	81	55
II	57	37	24	20	81	57
III	133	75	8	5	141	80
IV	28	22	373	345	401	367
V	107	48	253	132	360	180
VI	122	108	---	---	122	108
VII	13	13	62	60	75	73
VIII	52	19	---	---	52	19
IX	121	118	1	1	122	119
X	21	21	21	21	42	42
TOTALS	722	484	754	594	1,477	1,100

9) Adequate monitoring and laboratory practices including a QA/QC program and chain-of-custody procedures

10) Maintenance of pretreatment program records and procedures to compile data on new industrial users

11) Funding, staff, and equipment necessary to operate the program.

The following conclusions on the effectiveness of the 28 local programs audited were drawn:

- Most of the POTWs had sufficient legal authority to operate their programs effectively. Only two of the 28 ordinances contained serious deficiencies, lacking authority to take immediate action to halt an industrial discharge in an emergency situation that threatens human health or welfare.
- Twenty-five of the 28 programs audited faced multijurisdictional enforcement issues. Thirteen of the POTWs had not yet resolved all of the interjurisdictional issues they face. Lack of resolution in multijurisdictional situations means that there is no guarantee that enforcement actions can be taken against industrial users outside the boundaries of the municipality in which the POTW is located.
- Although all of the programs audited use or intend to use permits to regulate their industrial users, one third of the programs have ineffective permit systems. Deficiencies ranged from total lack of a system to failure to review and reissue expired permits.
- Half of the POTWs had written adequate enforcement procedures, but few of the POTWs have established policies that dictate when and what type of enforcement actions are to be taken. Many had never taken formal enforcement actions, although in seven cases there had been serious violations. Personnel from most of the POTWs that were audited expressed a reluctance to take any kind of formal action because it might affect their relations with the industrial community.
- All of the POTWs have Federally mandated prohibited discharge standards in their sewer use ordinances. Their record on enforcement of these standards was not ascertained. Enforcement of National categorical standards was generally poor. More than half of the POTWs audited had limits less stringent than categorical limits, did not apply the combined wastestream formula when appropriate, or did not yet know whether they had any categorical industrial users. Also, only four POTWs had implemented procedures to ensure that categorical industrial users comply with the reporting requirements in 40 CFR 403.12 (i.e., baseline monitoring reports, reports on compliance with categorical standards, and periodic reports on continuing compliance). Only half of the POTWs had developed technically based local limits.

- Monitoring programs were generally good. Twenty out of 28 had proper QA/QC prodedures. One deficiency was the lack of chain-of-custody procedures at half of the POTWs, which could seriously hamper subsequent enforcement actions. More than half of the POTWs lacked adequate safety procedures.
- Ten of the 28 POTWs had procedures for updating their industrial user data. Staff from most of the POTWs that were lacking procedures seemed to consider it an insignificant issue.
- Sixteen of 28 programs had adequate data management systems. The most common problem encountered was decentralized files, making a cross-checking of permitting, inspection, and enforcement files difficult.
- Four of the programs had major resource problems, primarily because they had underestimated their staff and funding needs when the program was developed.

Pretreatment Implementation Review Task Force (PIRT)

In February 1984, EPA established the Pretreatment Implementation Review Task Force (PIRT), to review the status of implementation of the National Pretreatment Program and to provide the Agency with recommendations for improving the program. The day-to-day problems faced by POTWs, States, industries, and EPA Regions in implementing the General Pretreatment Regulations and the Categorical Pretreatment Standards regulations were reviewed.(9) PIRT identified five basic areas where improvement is needed:

- Guidance to simplify and clarify the pretreatment program requirements
- Enforcement of the requirements
- Staffing and resources to implement the requirements
- Definition of the roles and relationship between EPA, States, and POTWs
- Regulatory revisions.

A full discussion of the PIRT recommendations is presented in the Pretreatment Implementation Review Task Force Final Report to the Administrator, EPA, Office of Water Enforcement and Permits, January 30, 1985.

In response to these recommendations, the following guidance materials have been prepared or are in some stage of development by EPA:

- Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standards (now available)
- Guidance Manual for Preparing and Reviewing Removal Credit Applications (now available)
- RCRA Notification Handbook (now available)
- Categorical Standards Guidance
- Combined Wastestream Formula Guidance (now available)
- Local Limits Guidance
- Sludge Disposal Regulations
- POTW Interference Guidance.

In addition to the above guidance materials, PIRT also made the following recommendations:

- EPA should expedite issuance of water quality standards
- EPA should expeditiously develop sludge management and disposal requirements
- EPA should publish guidance for the local regulation of private research and development and Federal facilities
- EPA should provide guidance on industrial monitoring frequency
- EPA should develop an inspection training program for POTWs
- EPA should develop a uniform data reporting format for the annual POTW report
- EPA and delegated States should step up their enforcement actions against POTWs without program applications
- EPA, delegated States, and POTWs with approved programs should step up their enforcement actions against industrial users not submitting BMRs and those not in compliance with categorical standards
- The Federal government through EPA should increase the resources available to implement the National Pretreatment Program by increasing manpower at EPA and increasing grant funding to States and POTWs.

Implementation Status of the Categorical Standards

The key vehicles for reducing toxic loadings to the Nation's sewers are the pretreatment standards for categorical industries. After initial delays, EPA has made considerable progress in promulgating these National standards. As shown in Table 6-6, pretreatment standards have been issued for 22 categorical industries and are proposed for one other industry. By the end of 1985, the pretreatment compliance dates for 12 industries will have passed, five will come due in 1986, four in 1987, and one in 1988.

Full implementation of the categorical standards will result in a significant reduction in toxic loadings to POTWs. Estimates of the controls afforded by categorical standards are provided in the next section. They hinge upon substantial industrial compliance with the categorical standards. For the few industries with compliance deadlines that have passed, it is difficult for EPA or States to assess industrial compliance rates. They are hampered by reporting discontinuities inherent to the General Pretreatment Regulations, the lack of a National tracking system, the decentralized administrative network, the large number of industries involved, and the inadequacy of resources for Federal and State oversight.

In spite of EPA's inability to make accurate comprehensive compliance projections for industries, selected assessments have been made that may be indicative of National compliance trends. EPA conducted a recent effort to evaluate the compliance status of 333 electroplating facilities associated with 15 major National corporations. In EPA's assessment of these major electroplating facilities, compliance information was available on 280 facilities and 78 facilities out of the 280 (28 percent) were found not to be in compliance according to BMRs or other compliance information as of September 1984. For an additional 52 facilities of the 280 (or 19 percent of major industries) compliance status could not be confirmed. Thus, compliance may be as high as 70 percent for these facilities. Table 6-7 summarizes the status of the facilities inventoried by EPA. Since the firms examined in this assessment were major corporations, it is conceivable that these numbers are higher than actual National compliance rates.

TABLE 6-6. SUMMARY STATUS OF NATIONAL CATEGORICAL PRETREATMENT STANDARDS: MILESTONE DATES

SUMMARY STATUS OF NATIONAL CATEGORICAL PRETREATMENT STANDARDS: MILESTONE DATES

FINAL REGULATIONS

Industry Category	Promulgation Date	Effective Date	BMR Due Date	PSES Compliance Date
Aluminum Forming	10-24-83	12-7-83	6-4-84	10-24-86
Battery Manufacturing	3-9-84	4-23-84	10-20-84	3-9-87
Coil Coating I	12-1-82	1-17-83	7-16-83	12-1-85
Coil Coating (Canmaking)	11-17-83	1-2-84	6-30-84	11-17-86
Copper Forming	8-15-83	9-26-83	3-25-84	8-15-86
Electrical Components I	4-8-83	5-19-83	11-15-83	7-1-84 (TTO)[3] 11-8-85 (As)
Electrical Components II	12-14-83	1-27-84	7-15-84	7-14-86
Electroplating	1-28-81	3-30-81	9-26-81 (Noninteg.) 6-25-83 (Integrated)	4-27-84 (Noninteg.) 6-30-84 (Integrated)
	7-15-83	8-29-83	2-25-84 (TTO)	7-15-86 (TTO)
Inorganic Chemicals I	6-29-82	8-12-82	5-9-83	8-12-85
Inorganic Chemicals II	8-22-84	10-5-84	4-3-85	6-29-85 8-22-87 ($CuSO_4$, $NiSO_4$)
Iron and Steel	5-27-82	7-10-82	4-6-83	7-10-85
Leather Tanning	11-23-82	1-6-83	7-5-83	11-25-85
Metal Finishing	7-15-83	8-29-83	2-25-84	6-30-84 (Part 433, TTO)[2] 7-10-85 (Part 420, TTO) 2-15-86 (Final)
Metal Molding and Casting	10-8-85	12-13-85	6-11-85	10-31-88
Nonferrous Metals Forming	8-23-85	10-7-85	4-5-86	8-23-88
Nonferrous Metals I	3-8-84	4-23-84	10-20-84	3-9-87
Nonferrous Metals II	9-20-85	11-4-85	5-3-86	9-20-88

TABLE 6-6. SUMMARY STATUS OF NATIONAL CATEGORICAL PRETREATMENT STANDARDS: MILESTONE DATES (Continued)

SUMMARY STATUS OF NATIONAL CATEGORICAL PRETREATMENT STANDARDS: MILESTONE DATES (Continued)

FINAL REGULATIONS

Industry Category	Promulgation Date	Effective Date	BMR Due Date		PSES Compliance Date
Pesticides	10-4-85	11-18-85	5-17-86		11-18-88
Petroleum Refining	10-18-82	12-1-82	5-30-83		12-1-85
Pharmaceuticals	10-27-83	12-12-83	6-9-84		10-27-86
Plastics Molding and Forming	12-17-84	1-30-85	7-29-85		--[1]
Porcelain Enameling	11-24-82	1-7-83	7-6-83		11-25-85
Pulp, Paper, Paperboard	11-18-82	1-3-83	7-2-83		7-1-84
Steam Electric	11-19-82	1-2-83	7-1-83		7-1-84
Textile Mills	9-2-82	10-18-82	4-16-83		--[1]
Timber Products	1-26-81	3-30-81	9-26-81		1-26-84
PROPOSED REGULATIONS					
Organic Chemicals	(3-86)	(5-86)	(11-86)	(5-89)	3-21-83

Parentheses indicate expected milestone dates for categories that do not yet have final standards.

Footnotes:

(1) No numerical pretreatment limits have been established for these industrial categories, and there is no final compliance date for categorical pretreatment standards. Firms in these categories are required to comply only with the General Pretreatment Regulations in 40 CFR 403.

(2) Existing sources that are subject to the Metal Finishing standards in 40 CFR Part 433 must comply only with the interim limit for Total Toxic Organics (TTO) by June 30, 1984. Plants also covered by 40 CFR Part 420 must comply with the interim TTO limit by July 10, 1985. The compliance date for Metals, Cyanide, and final TTO is February 15, 1986 for all sources.

(3) The compliance date for existing Phase I Electrical and Electronic Components manufacturers for TTO is July 1, 1984. The compliance date for arsenic is November 8, 1985.

Note: The compliance date for any New Source (PSNS) is the same date as the commencement of the discharge.

TABLE 6-7. COMPLIANCE STATUS OF MAJOR ELECTROPLATING FACILITIES BY EPA REGION

		ALL COMPLIANCE INFORMATION[b]			
			Evaluated Compliance Based on all Information		
Region	Number of Facilities Identified	No. of Facilities With Compliance Information Located	Yes (%)[c]	No (%)	UNK (%)
I	15	14	4 (29)	4 (29)	6 (42)
II	31	27	10 (37)	12 (44)	5 (19)
III	25	21	10 (48)	6 (28)	5 (24)
IV	39	26	9 (35)	4 (15)	13 (50)
V	153	133	83 (62)	36 (27)	14 (11)
VI	14	10	7 (70)	2 (20)	1 (10)
VII	16	14	6 (43)	6 (43)	2 (14)
VIII	2	1	0 (0)	0 (0)	1 (100)
IX	33	29	17 (59)	8 (28)	4 (14)
X	5	5	4 (80)	0 (0)	1 (20)
TOTAL	333	280	150 (54)	78 (28)	52 (18)

[a] Percentages in parentheses are based on the number of facilities with BMRs located.

[b] Includes all types of information: BMRs, POTW records, and industry-reported compliance data.

[c] Percentages in parentheses are based on the number of facilities with compliance information located.

6.3.2 Effectiveness of Categorical Standards

Scope of Categorical Standards/Industrial Categories Regulated

EPA has already promulgated or will promulgate categorical pretreatment standards for 23 of the 34 industrial categories listed in the NRDC consent decree. Once fully promulgated and implemented, these standards will encompass at least 14,000 industrial users, including discharge sources in important industrial categories such as the metal finishing, pesticides manufacture and formulation, and organic chemicals, plastics and synthetic fibers categories. At the same time, the Agency has determined, by authority of Paragraph 8 of the NRDC Consent Decree, that national categorical standards for all or part of twelve other industrial categories, including paint formulation, printing and publishing, and auto and other laundries are not necessary. Sources in these categories are still regulated under prohibited discharge standards (e.g., pH, fire/ explosion, interference) enumerated in the general pretreatment regulations (see 40 CFR Part 403), and may also be specifically regulated under provision of local POTW ordinances.

Based on the scope of the NRDC consent decree and the extent of Paragraph 8 exemptions, potential industrial sources of hazardous waste discharges to POTWs may not currently be regulated by categorical standards. These potentially unregulated sources include new, emerging industries (e.g., waste reduction, waste treatment) that are not addressed in the Consent Decree, and smaller, more numerous service-oriented industries (e.g., laundries, printing/ publishing operations, motor vehicle services) that tend to discharge smaller quantities of toxic pollutants on a facility-specific basis. Moreover, many industrial sources practicing intermittent batch discharge of wastes (e.g., spent solvents, off-spec products) are not currently regulated by categorical standards either because these discharge practices could not be adequately characterized by industry sampling programs supporting rulemaking or because these practices, by themselves, did not provide an adequate basis for regulating an entire category.

Scope of Categorical Standards/Priority RCRA Constituents Regulated

As discussed above, the effluent guideline rulemakings have focused almost exclusively on the control of the 126 compounds on the priority pollutant list. Because heavy metals are well represented on the priority pollutant list and heavily regulated under categorical standards, implementation of existing categorical standards should produce substantial reductions in loadings of hazardous metals (e.g., lead, cadmium, nickel) to POTWs. The Chapter 3 industry assessment projects a 95 percent reduction in total priority metals loadings to POTWs, and substantial reduction for major metals sources such as the metal finishing, battery manufacturing, leather tanning and inorganic chemicals industries.

Implementation of existing and proposed categorical standards will result in less extensive control of discharges of organic hazardous constituents by industrial sources than of metals. The Chapter 3 industry assessment projects a 47 percent reduction in loadings of total organic hazardous constituents (priority pollutants only) with full PSES implementation, assuming successful promulgation of proposed categorical standards for key organics sources such as the organic chemicals industries. The analysis shows that significant organics sources (e.g., pharmaceuticals, laundries, equipment manufacturing, wood refinishing, petroleum refining) are largely unregulated under existing categorical standards.

Limitations of categorical standards on the control of certain toxics discharges, especially organics discharges, may be tied to the following factors:

- Scope of Paragraph 8 exemption. Under the CWA, the Agency must regulate pollutants which interfere with, pass through, or are otherwise incompatible with POTWs. Under Paragraph 8 of the Consent Decree, however, EPA may exclude from regulation by national categorical standards categories and pollutants based on a number of considerations including adequacy of analytical methods, treatability, or redundancy with other pretreatment standards. Most significantly, the Agency may exempt subcategories if such subcategories comprise less than 5 percent of sources, discharge compatible pollutants, or where quantities of incompatible pollutants are considered insignificant. The Agency has used the Paragraph 8 exemption, in some cases, to support decisions not to regulate toxic pollutants detected in discharges by various sources.

- Uncertainty about volatilization in POTWs. In order to determine whether a pollutant is incompatible with POTW, the Agency has traditionally compared BAT technology removal rates with POTW removal rates, regulating the pollutant where POTW removal rates are less than (or significantly less than) BAT removal rates. This pass through analysis, then, depends heavily on availability of adequate experimental and empirical data on industrial and POTW removal rates. The 40 POTW study provided some data on removal rates for certain priority pollutants, especially organics, but these rates were extremely high due to volatilization. To date, EPA has included air emissions from the POTW in its calculation of a POTW's removal of pollutants from wastewater. This has the effect of increasing the calculated POTW removal rate, sometimes resulting in a higher removal rate than that achieved by BAT. This calculation may, in turn, result in a decision that the pollutant does not pass through the POTW and that pretreatment standards thus need not be promulgated. Citing concerns about worker safety and health, ozone formation and air toxics, the Agency, as part of the OCPSF rulemaking, has stated its intent not to consider pollutant volatilization to be considered removal. If successfully applied, this principle would result in the control of an increased number of volatile organic compounds currently discharged to POTWs.

- Consideration of POTW interference. In reliance on the prohibited discharge standards, EPA has placed considerably less emphasis in PSES rulemakings on the potential for interference with POTW processes/operations as a result of toxics discharges by industrial sources. Examples of possible interference include fires/explosions, sewer line corrosion, worker illness, inhibition, or upset of biological treatment systems, and sludge contamination. With few exceptions, e.g. leather tanning, the Agency has not undertaken systematic collection of data (other than request for comments during rulemakings) on these types of POTW incidents in support of rulemakings for specific industrial categories. Analysis of data collected for the DSS study reveals that certain industries are frequently cited as "problem industries" by POTWs. These incidents often stem from irregular discharge practices, especially intermittent batch dumping, which are difficult to detect through routine monitoring by EPA, State, and POTW officials.

These and other considerations have, in some instances, hindered Agency efforts to establish national categorical standards controlling toxics discharges to POTWs.

Scope of Categorical Standards/Nonpriority RCRA Constituents Regulated

Because PSES rulemakings have focused largely on the 126 priority pollutants, categorical standards may not ensure adequate control on the discharge of other nonpriority RCRA hazardous constituents by industrial sources. To the extent to which these constituents are treated incidentally along with regulated wastestreams, significant removal may be realized. However, incidental removals may be countered by wastestream segregation. Currently, the RCRA Appendix VIII constituent list contains approximately 250 compounds, mostly organics, which are not included on the priority pollutant list. The Chapter 3 industry assessment demonstrates that some industrial categories, including the organic chemicals, pesticides, and pharmaceutical industries, discharge substantial quantities of these nonpriority hazardous constituents in process wastewaters. POTW influent sampling data collected for this study also shows that a small number of nonpriority constituents are discharged to POTW systems in significant quantities.

A major impediment to regulation of nonconventional pollutants under categorical standards has been the lack of information on treatment and removal of these pollutants by industrial and POTW treatment technologies. Without this information, EPA cannot conduct the traditional pass through analysis used to support PSES rulemakings. Recently, in conjunction with PSES rulemaking for the pesticide manufacture and formulation category, the Agency has utilized a principle known as "technology transfer" in an attempt to regulate numerous nonconventional pesticide parameters. Technology transfer allows EPA to project removal rates for nonconventional parameters by extrapolating from available treatability data for compounds with similar physical and chemical properties. If successfully applied, technology transfer could provide a basis for the regulation of certain RCRA constituents in the absence of a massive sampling program to assess removal of these compounds by industrial and POTW treatment systems.

To date, the Agency has not exercised its CWA Section 307(a) authority to add pollutants to the priority pollutant list. Moreover, the Paragraph 4(c) Program has not resulted in additional regulation of toxics discharged by various industrial sources. Under Paragraph 4c of the Consent Decree, EPA is required to identify and regulate, based on examination of data collected for BAT/PSES rulemakings, additional compounds detected in industrial discharges and determined to be incompatible with POTW treatment systems. In evaluating the 1,565 compounds detected in industrial wastewaters, the Agency identified six incompatible compounds discharged by industrial sources. EPA has not yet completed regulatory action to control the discharge of these compounds. Because of its limited scope the Paragraph 4(c) Program has yet to provide an effective tool for the control of nonpriority RCRA constituents (see Chapter 2 for more information).

6.3.3 Effectiveness of Prohibited Discharge Standards

Under the General Pretreatment Regulations, prohibited discharge standards include general and specific prohibitions on the discharge of certain wastes to POTWs. Also, POTWs must develop local limits as necessary to implement these prohibitions. Importantly, prohibited discharge standards apply to pollutant discharges to POTWs from any nondomestic sources. As a result, these standards may be applied to a range of industrial categories not currently regulated under national categorical standards. This section evaluates application of existing prohibited discharge standards, including local limits, to control hazardous waste discharges to POTWs by diverse industrial sources.

General Prohibitions

These provisions prohibit the discharge by any nondomestic source, of pollutants that interfere with the operation or performance of a POTW or pass through a POTW. At the present time, EPA has suspended the regulatory definitions for "interference" and "pass through" due to litigation involving the issue of causation. Under recently proposed definitions, interference and pass through are defined as follows:[4]

- Interference - means a discharge by an industrial user which, alone or in conjunction with discharges by other sources, inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal and which is the cause of a violation of
- Pass through - means discharge of pollutants through a POTW into navigable waters in quantities or concentrations, which, alone or in conjunction with discharges from other sources, is a cause of a violation of any requirement in a POTW's NPDES permit or of the prevention of sewage sludge use or disposal in accordance with Federal, State or local law.

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[4] See 50 FR 25526-27, June 19, 1985 for discussion of proposed definitions.

The general prohibition against interference provides a legal basis for the control of some hazardous waste discharges to POTWs. The prohibition can be most effective in the control of intermittent slug load discharges of hazardous wastes causing sudden inhibition or upset of biological treatment processes. Enforcement of this prohibition, however, has been complicated by technical difficulties confronted by POTWs in identifying the specific pollutants which caused the inhibition or upset, and the source(s) of the offending discharge. These technical difficulties are reflected in POTW incidents evaluated in this study. Frequently, POTWs refer to generic pollutant classes (e.g., solvents, organics) or unknown pollutants as the causative agents for process or operational interferences and to suspected or unknown sources of these pollutant slug loads. The interference prohibition tends to be less effective in instances where toxic discharges only inhibit treatment processes, resulting in marginal permit violations or decreased plant efficiency.

Enforcement of the prohibition against discharges that contaminate sludge are currently hindered by the absence of Federal, State and local standards governing use and disposal of sewage sludge for some contaminants that may be of concern. Currently, CWA Section 405 sludge use and disposal criteria contain few limitations on toxic pollutants, especially organics. As mentioned, these criteria are currently being developed. Now, where contamination occurs, POTWs may have substantial difficulty in ascertaining sources of the offending discharges, and apportioning liability for sludge contamination among these sources.

The prohibition against pass through is presently less effective in controlling hazardous waste discharges to POTWs due to the absence of water quality standards and water quality-based NPDES effluent limitations governing discharges of toxic pollutants, especially organics. Moreover, there are few Federal water quality criteria to assist States in establishing water quality standards for nonpriority hazardous constituents. Consequently, there are few enforceable standards or criteria defining when pass through has actually occurred. In certain instances, NPDES permits may contain priority pollutant limits and generic prohibitions against discharges that harm aquatic life or receiving waters, but enforcement of these requirements will almost certainly require extensive monitoring (water quality monitoring, biomonitoring, bioassays) over time to determine causative pollutants and sources.

Specific Prohibitions

Specific prohibitions forbid the discharge of specific types of materials which can have deleterious effects on POTW collection and treatment systems. Currently, pretreatment regulations contain five specific prohibitions applying to:

- Pollutants which create fire/explosion hazard
- Pollutants which cause corrosive damage
- Pollutants which cause obstruction to flow within a POTW
- Pollutants which cause interference with a POTW
- Heat inhibiting POTW biological activity.

Specific prohibitions also apply to any nondomestic source discharging waste to a POTW. Because specific prohibitions tend to apply at the point of industrial discharge, these prohibitions provide more effective control over discharges of hazardous wastes, particularly characteristic hazardous wastes. Still, certain prohibitions remain somewhat vague in scope, particularly when compared with the greater specificity of testing procedures used to characterize hazardous waste. The discussion below focuses exclusively on specific prohibitions for fire and explosion hazards and for corrosivity. The interference prohibition is analogous to the general prohibition for interference discussed above, while prohibitions on heat and obstruction relate only peripherally to the control of hazardous waste discharges.

The specific prohibition relating to fires and explosion applies to "pollutants which create a fire or explosion hazard in the POTW." This provision can be and has been utilized to control discharges of certain RCRA characteristic wastes, particularly ignitable wastes and reactive wastes. The RCRA characteristic of ignitability (40 CFR 261.21) encompasses waste which:

- Is a liquid, other than aqueous solution containing less than 24 percent alcohol by volume and has a flash point less than 60 degreees Centigrade
- Is not a liquid and is capable under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard
- Is an ignitable compressed gas or an oxidizer pursuant to 49 CFR Part 173.

The RCRA characteristic of reactivity (40 CFR 261.23) encompasses waste which:

- Is normally unstable and readily undergoes violent change without detonating
- Reacts violently with water
- Forms potentially explosive mixtures with water
- When mixed with water or because it is cyanide or sulfide bearing waste exposed to pH between 2 and 12.5, it generates toxic vapors which may present a danger to human health or the environment
- Is capable of detonation or explosive reaction or decomposition at standard temperature and pressure, or if subjected to strong initiating source or heated under confinement
- Is a forbidden, Class A or Class B explosive pursuant to 49 CFR Part 173.

The pretreatment prohibition is broad enough in scope to control many of these RCRA wastes. However, POTWs need further clarification and guidance to more effectively utilize this regulatory tool to control ignitable and reactive materials. Additional clarification and guidance would help POTWs improve their ability to identify in advance those situations in which a fire or explosion is likely to occur. Existing controls on ignitable and reactive compounds are not being applied as effectively as possible, as reflected in the Chapter 3 industry assessment, which shows the discharge of millions of kilograms of ignitable materials such as aromatic hydrocarbons, ketones, and aldehydes, and in the POTW incident file which documents numerous discharges causing or creating a risk of fire or explosion in POTW systems (see Appendix K).

Although many POTWs have adopted generic fire and explosion provisions analogous to the Federal provision, numerous other POTWs have enacted provisions incorporating standardized measures for fire and explosion hazard or prohibiting the discharge of certain pollutants and pollutant classes. As an example of the former case, six of 33 POTW ordinances reviewed for this study contain the following provision:

> "At no time, shall two successive readings on an explosion hazard meter, at the point of discharge into the [POTW] system (or at any point in the system) be more than five percent (5%) nor any single reading over ten percent (10%) of the Lower Explosive Limit (LEL) of the water."

One ordinance contains a provision utilizing a flashpoint measure (235°F using closed cup method) to regulate the discharge of liquid waste to public sewers. Another ordinance explicitly prohibits the discharge of materials such as gasoline, naphtha, kerosene, paints, lacquers, fuel oil, and other petroleum products. A more extensive provision, found in several POTW ordinances, limits the discharge of seventeen organic materials including:

- gasoline
- kerosene
- naphtha
- benzene
- toluene
- xylene
- ethers
- alcohols
- ketones
- aldehydes
- peroxides
- chlorates
- perchlorates
- bromates
- carbides
- hydrides
- sulfides

These types of ordinance provisions should drastically curtail use of sewers for disposal of organic compounds, especially solvents commonly associated with degreasing and painting operations. Where these "zero discharge" provisions have been enacted, banned materials such as benzene, toluene, and xylene have still been found in POTW influent wastewaters in significant quantities, suggesting the need for more aggressive enforcement.

Many POTWs have also enacted additional provisions regulating materials considered reactive wastes. Some POTWs have adopted numerical limits to control pollutants, such as cyanide and sulfides, which may cause wastes to assume reactive characteristics. Several of the ordinances reviewed for this study also contain a provision prohibiting the discharge of wastes which may generate toxic forms under conditions found in POTW collection and treatment systems.

The specific prohibition applying to corrosive wastes forbids the discharge of:

> "Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges."

The RCRA characteristic of corrosivity (40 CFR 261.22) applies to waste which:

- Is aqueous and has a pH less than or equal to 2 or greater than 12.5 or
- Is liquid and corrodes steel at a rate greater than 6.35 mm per year at a test temperature of 55 degrees Centigrade.

By prohibiting wastes with a pH less than 5.0, the specific prohibition on corrosive wastes will, if fully enforced, provide sufficient control on the discharge of acidic (i.e., low pH) hazardous waste to sewers. The pretreatment provision as is, however, does not contain a corresponding numerical pH limitation on discharge of caustic wastes (i.e., high pH), and therefore may not adequately control the discharge of these wastes to POTWs. Based on a review of 33 ordinances for this study, many POTW ordinances contain more stringent numerical limits on the discharge of caustic wastes. Generally ranging between 9.0 and 11.0, these maximum pH limitations will, if adequately enforced, prevent the discharge of caustic hazardous waste at these POTWs.

Local Limits

Under the General Pretreatment Regulations, POTWs administering local pretreatment programs must develop and enforce local limits to implement general and specific prohibitions. Although this limit-setting process offers substantial potential for improved control of hazardous wastes discharges, efforts by EPA, States, and POTWs to establish effective local limits have met with only limited success. Confusion surrounding the interpretation of regulatory requirements, the limited number of toxics criteria for water quality protection and use and disposal of sewage sludge, and inadequate resources have significantly hindered the development, by POTWs, of local limits to control toxics discharges.

Based on a review of 33 POTW ordinances conducted for this study, it would appear that most ordinances already contain numerical limitation on the discharge of heavy metals, including EP toxic metals such as arsenic, cadmium, chromium, and lead. POTW ordinances may also contain numerical limits controlling other pollutants such as cyanide, phenols, and sulfides. Some ordinances ban or restrict the discharge of certain highly toxic and persistent compounds, particularly chlorinated pesticides and herbicides. Few ordinances, however, contain specific numerical limits designed to control the discharge of common organics such as chlorinated solvents. Only 2 of 33 ordinances reviewed contain limits for common solvents such as benzene, ethyl benzene and methylene chloride. Both of these two ordinances, however, regulate at least one nonpriority organic pollutant (e.g., carbon disulfide, acetone, methanol, methyl ethyl ketone, cresols, isobutanol).

Many numerical limits currently contained in POTW ordinances have resulted from the use of limit-setting methodologies which do not consider the systematic effects (i.e., interference, pass through) of toxics discharges on POTW systems. A report summarizing the findings of pretreatment program audits conducted at 28 POTWs indicated that over half of the POTW ordinances did not contain limits derived from a technical analysis of interference and pass through concerns. In fact, it appears that some POTWs do not enforce limits contained in their ordinances based on their conclusions that their numerical limits are derived from questionable limit-setting methodologies (e.g., adopted from other ordinances) or would, in their opinion, be unrealistically stringent if actually enforced against nondomestic sources discharging the regulated pollutant.

To address these concerns about development and enforcement of local limits, EPA has established a national policy designed to clarify regulatory requirements relating to local limits. Under this policy, a POTW must perform the following three functions in setting limits:

- Perform industrial waste survey and sample influent, effluent, and sludge to identify pollutants of concern
- Determine, using best available information, the maximum loadings which can be accepted by the treatment works without occurrence of pass through, interference, or sludge contamination
- Implement a system of local limits to assure that these loadings will not be exceeded.

At a minimum, EPA will require POTWs to conduct this technical evaluation for six metals, including cadmium, chromium, copper, lead, nickel and zinc. In addition, based on site-specific information, the POTW must identify other pollutants of concern which might reasonably be expected to be discharged to the POTW in quantities which could pass through or interfere with the POTW, contaminate the sludge, or jeopardize worker safety and health. Nevertheless, without more technical information available to municipalities on POTW interference, and pollutant fate and effects, POTWs will have a difficult time developing local limits.

6.3.4 Effectiveness of Spill Control and Liquid Waste Hauler Controls

Two sources of hazardous waste discharges present special control challenges to POTWs within the context of their pretreatment programs -- spills and discharges by liquid waste haulers. Neither is comprehensively addressed in the General Pretreatment Regulations, although program mechanisms and procedures may operate to minimize some of the risks associated with these sources. The following subsections examine applicable pretreatment controls, estimate the occurrence of spills and liquid waste hauler discharges to POTWs, and highlight additional efforts taken by municipalities to address these sources.

Spills

The principal pretreatment provision directly pertaining to spills is the requirement in 40 CFR 403.12 that industries subject to categorical standards notify POTWs of slug loads of pollutant discharges that, because of flow rate or concentration, will interfere with or pass through the POTWs. No mandatory follow-up is required, preventative measures are not specified, and imposition of fines is not required. In addition, the prohibited discharge standards and categorical standards may serve to regulate the presence and concentration of constituents in spills. As discussed earlier, CERCLA exempts spills and discharges to POTWs from reportable quantity spill reporting requirements, provided that pretreatment standards are met. Thus, formal pretreatment controls for spills are, essentially, incidental to overall toxics regulation at POTWs.

Results from the AMSA survey, as well as a review of incidents at other POTWs, indicate that spills to sewage treatment plants are frequent occurrences. Roughly two-thirds of all AMSA respondents reported that hazardous wastes had been discharged to their plants as a result of spills. Perhaps as a result, the AMSA respondents have taken steps beyond the pretreatment regulations to prevent spills. According to the survey, virtually all AMSA members require notification of spills, roughly two-thirds have comprehensive accidental spill prevention programs for their POTWs, and three-quarters report that they require industries to take spill prevention measures.

These results are somewhat contrary to other observations from audits and program reviews which indicate that less than half of all POTWs have spill containment and prevention programs. Deficiencies observed include a lack of information on materials stored onsite, a lack of resources necessary to inspect potential dischargers, and an inability to identify a set of industries which constitute potential toxic dischargers. Also, system size and inadequacy of sampling procedures may make spill identification difficult.

Nonetheless some industries and POTWs do engage in extensive spill control and prevention measures. The State of Pennsylvania, for example, requires all industries and commercial facilities to prepare and submit Preparedness, Prevention and Contingency Plans. EPA Region X is requiring all pretreatment POTWs to develop and implement spill plans and is developing an accidental spill prevention plan guidance manual to assist POTWs in identifying likely industries, pollutant sources, and effective cleanup measures.

Components of local programs can easily be adapted to incorporate spill measures. Some POTWs impose spill prevention measures (berms, contained storage areas) in industrial permits. Others require IUs to submit formal spill containment plans. Some POTWs have inspectors who conduct routine inspections, look for potential spill conditions, and issue corrective orders where necessary. Many municipalities have established communication links with area fire and rescue departments so that POTWs are informed before highway spills are flushed into sewers. Sensitivity to spills seems to be increasing, and as a result further adaptions of pretreatment controls may be expected.

Control of Liquid Waste Haulers

Discharges from liquid waste haulers are subject to the same categorical standards, general and specific prohibitions, and local limits that any industrial discharger to a POTW is under the pretreatment program. RCRA singles out POTWs receiving hazardous wastes by truck or rail for regulation under permit-by-rule.

Given their mobility and the variability of waste hauled, these sources do present unique enforcement issues for POTWs. The AMSA survey(3) indicates that a substantial subset of POTWs receive wastes containing hazardous constituents from liquid septage haulers (32 percent) and other liquid waste haulers (23 percent of AMSA respondents). As described earlier, subsequent discussions with POTW operators of these systems indicated that these POTWs have not knowingly received manifested hazardous wastes from haulers. As also described earlier, these POTWs have developed monitoring programs to identify haulers seeking to dispose of hazardous waste and have turned these haulers away. Forty percent of POTWs reported midnight dumping of hazardous wastes to their systems. Mobile sources are a likely suspect in these situations. At the same time, AMSA cities report a diversity of special control measures for liquid waste haulers. Sixty percent employ permits or agreements with the specific trucking firm and 74 percent require the disposal of wastes at designated points in the system (usually at a designated manhole or at the plant itself). Interestingly, 17 out of the 66 POTWs require permits with the actual waste source, rather than the transporter, and 20 cities employ a manifest system. Roughly 60 percent of the cities perform some sampling on batches prior to discharge.

Mobile sources do present unique control problems for cities. As introduced by AMSA results, POTWs have employed four basic types of controls:

- Control mechanisms - permits and manifests
- Waste standards and limits
- Discharge point to the POTW
- Monitoring requirements - trucker, IU or POTW.

Each is discussed below.

POTWs usually employ a variety of control mechanisms to track the disposal of liquid wastes. Some POTWs provide general permits to trucking firms; others develop a permit for each discharge. In addition a cradle-to-grave manifesting system involving all parties may be employed. This is analogous to RCRA's permitting system.

POTWs that allow waste haulers to discharge to their systems sometimes have separate standards and limits which may be more or less stringent than those for IUs. Hauler discharge standards can range from allowing only domestic septic wastes to allowing discharges of other nonhazardous industrial waste.

The discharge point(s) set aside by POTWs for waste haulers and the controls available at the point(s) can affect the types and quantities of wastes discharged. If the discharge point is at the treatment plant or other controlled point (i.e., where a POTW worker can check and prevent the discharge if necessary), the types of wastes that the waste hauler will discharge are more likely to meet the POTWs standards. In addition, if the POTW has facilities to hold wastes prior to discharge, analytical results can be evaluated prior to discharge. However, if the discharge point is uncontrolled, then the hauler has the potential to discharge any kind of waste.

Related to the discharge point and whether or not it is controlled are the POTW's monitoring requirements. Some POTWs require or conduct an analysis of every load of waste prior to discharge; other POTWs do random analysis or perform visual, pH, or other simple tests to check the waste prior to discharge. Others, however, only require the hauler to log in or report to the POTWs that a load has been discharged. Rarely do POTWs have time to examine analytical results prior to discharge. However, truckers know that if they discharge any prohibited wastes, they may be banned from future use of the POTW as well as being subject to CWA enforcement action.

Waste hauler controls the POTW utilizes should vary with the types and quantities of wastes discharged. If the POTW combines strict waste standards and limits with a controlled discharge point and regular monitoring, this control method should reduce and possibly eliminate hazardous waste discharges from waste haulers.

Liquid waste haulers also present a distinct enforcement challenge. The threat of terminating sewer service, which tends to be an effective method for correcting illegal discharges from fixed sources, can only be employed as an enforcement tool against mobile sources, such as septic haulers, that regularly utilize POTW facilities. Some States and localities have established ad hoc hazardous waste strike forces to cope with these problems, particularly where they transcend State and local jurisdictional boundaries. Many POTWs have not yet developed extensive procedures for detecting and investigating hazardous waste discharges by mobile sources.

6.3.5 Municipal Perceptions on the Need for Hazardous Waste Control at POTWs

The foregoing subsections constitute an evaluation of the effectiveness of pretreatment program components in controlling DSE wastes. This analysis suggests that after some delay, significant progress has been and continues to be made to implement pretreatment programs and standards. Substantial toxic reductions have been realized at some POTWs (especially for metals) and increased compliance by industrial facilities currently subject to categorical standards (e.g., the electroplating and metal finishing industries) should bring about further reductions. However, little control has been directed at nonpriority hazardous constituents. In addition, evaluation of specific prohibitions and local limits suggest that these mechanisms have been employed effectively by some cities to address local problems from industries such as paint plants and industrial laundries. Given additional technical assistance and regulatory incentives (toxic permit limits for POTWs, sludge criteria), more POTWs could develop local limits designed to prevent the discharge of deleterious hazardous waste to their systems. Finally, controls have also been adopted for spills and mobile sources.

A principal determinant affecting existing and future municipal efforts to control hazardous wastes is local perception of the existence and severity of problems associated with hazardous waste discharges. Do POTWs know whether hazardous wastes are being discharged to their systems? Are they sampling to ascertain the presence and sources of these wastes? What impacts have been felt as a result of these wastes? What responses have cities taken and what future regulatory steps should be pursued to address hazardous wastes? As a final step in estimating the potential effectiveness of local pretreatment activities in controlling hazardous wastes, AMSA POTW responses to these questions are considered.

- Hazardous Waste Discharges to Municipal Sewers[5]

  Two-thirds of AMSA's responding POTWs report that hazardous wastes are discharged to municipal collection systems. When queried about the types of wastes they receive, cities indicated receiving the full gamut of waste types. The top three wastes were corrosive wastes, solvents, and plating baths/sludges, reported at over half of the responding POTWs. Listed and ignitable wastes had been discharged to one-third of the POTWs. The most frequently reported reason for hazardous wastes entering systems was spills reported by 60 percent of POTWs. Batch, routine, and illegal discharges were mentioned by half of all the responding cities as generic waste sources. Forty percent of AMSA cities reported midnight dumping in their systems. Twenty percent of the AMSA systems indicated that they received wastes from hazardous waste treatment facilities. Further, POTW respondents reported a significant increase in hook-up requests from hazardous waste treatment or reclamation facilities in 1984 and 1985. None of these data indicates the volume or frequency of hazardous waste receipt to AMSA POTWs.

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[5] In response to the survey, POTWs reported on practices involving what they believed to be hazardous wastes as defined by RCRA. Therefore, the term "hazardous wastes" should be construed here to refer to wastes and wastewaters (e.g., electroplating baths), as opposed to specific hazardous constituents.

- Municipal Hazardous Waste Sampling and Analytical Efforts

Virtually all of the AMSA respondents indicate that they perform sampling and analysis of plant influents, effluents, and industrial effluents for hazardous wastes (57, 61, and 62 POTW affirmative responses, respectively). In terms of the specific pollutants analyzed, all POTWs report performing metals analysis, while roughly half of the cities engage in toxic organics analysis. Eighty percent of the AMSA respondents report making special efforts to identify hazardous waste discharges in their systems. These efforts ranged from special sampling studies (e.g., Seattle Metro's Toxicant Pretreatment Study) and manhole surveillance programs, to demand monitoring after spills.

- Impacts of Hazardous Wastes Discharged to Sewers

The results of the AMSA survey pertaining to impacts experienced due to hazardous wastes receipt are anomalous. One quarter of the responding municipalities indicated that problems had occurred at their plants due to hazardous wastes. Yet when specific impacts were explored, almost half reported explosions, fires, or threats thereof and almost an equal number reported corrosion in their collection systems. Forty percent of the AMSA respondents indicate that industrial wastes caused upsets of biological treatment and 25 percent reported NPDES permit violations associated with industrial wastes.

- Control of Hazardous Waste Discharges

Fifty-nine out of the 66 AMSA respondents assert that they have regulatory controls in place to control hazardous wastes. The vast majority report that they have local limits for metals, and over half had limits for toxic organics. Two-thirds of the cities do not believe that a lack of Federal standards or effects or control technology information has deterred from local efforts to control hazardous discharge. However, 60 percent of the respondents acknowledged a need for increased regulation of toxic organics. There was no consensus on the best approach to fill this need although local limits were preferred over promulgation of additional Federal categorical standards.

As expressed initially, the representativeness of AMSA survey results for all U.S. POTWs is not asserted. While an excellent data source, encompassing roughly half of the industrial discharges estimated nationally, AMSA cities are believed to be larger, more urban, and more sophisticated than the POTWs nationally. With this caveat in mind, the survey results do confirm that many sewage treatment plants are receiving hazardous wastes, that efforts to identify and regulate hazardous wastes are being undertaken, and that impacts are being felt at POTWs. Further, municipalities indicate that they expect hazardous waste discharges to increase and additional controls to be warranted.

6.4 CONCLUSIONS

This chapter has presented an overview of hazardous waste management requirements under RCRA, wastewater treatment and pretreatment requirements under the CWA, and other relevant statutory authorities which may affect the discharge or subsequent release of DSE wastes to the environment. In particular, controls on the discharge of hazardous wastes to sewers under the DSE by industrial users/generators have been discussed. In addition, the regulatory obligations of POTWs receiving both DSE wastes and hazardous wastes have been discussed.

The purpose of this analysis was to determine if current regulatory mechanisms and statutory authorities are adequate to control impacts from the discharge of DSE wastes. This evaluation has focused mainly on the effectiveness of existing controls, with efforts having been made to take implementation status and compliance rates into account. However, possible improvements to programs being implemented under existing statutory authorities have also been factored into this evaluation.

The overall finding which can be drawn from this regulatory evaluation (and the technical findings contained in the preceding chapters) is that sufficient authorities exist under the CWA and RCRA to control the known impacts associated with the discharge of hazardous wastes to sewers, and that substantial amounts of priority pollutant hazardous waste constituents have been regulated under CWA authorities. This basic finding supports retention of the domestic sewage exclusion at the present time, recognizing the logic of RCRA's reliance, principally, on the CWA's pretreatment program, for regulation of the discharge of aqueous hazardous wastes to sewers. At the same time, the foregoing analysis has identified gaps in existing Federal pretreatment standards and weaknesses in local pretreatment programs which could be improved (under existing authorities) to better protect human health and the environment.

Additionally, a basic lack of information on releases to ground water and air from POTWs as a result of hazardous (as well as other domestic and industrial wastewater) discharges suggests that further study be undertaken to evaluate potential impacts prior to the assessment of the need for additional regulatory controls. Existing CWA authorities, supplemented by RCRA, could probably be applied to reduce impacts, if found. Nevertheless, both impacts and control options need more extensive study before final conclusions or recommendations can be drawn.

Supplemental points supporting the above conclusion are provided in the following discussions of: 1) the logic and rationale for the domestic sewage exclusion; 2) the effectiveness of CWA pretreatment controls; and 3) the appropriateness of other CWA/RCRA controls on POTWs receiving hazardous waste.

6.4.1 The Logic and Rationale for DSE: Effective Interaction Between CWA and RCRA

The domestic sewage exclusion (DSE) coordinates the regulatory controls imposed by RCRA and CWA. Under the DSE, discharges of hazardous waste mixed with domestic sewage remain regulated under the CWA, including the CWA's pretreatment requirements. Major pretreatment program controls have traditionally emphasized the control of waste by treatment, at the industrial source, and prior to discharge to public sewers. Treatment of the concentrated industrial wastewater prevents the discharge of hazardous constituents to POTW collection systems and thus minimizes the release of these constituents to all media, including surface water, sludge, air, and ground water. Certainly, the information and analysis included in the report does not question the logic of continuing this approach of control of pollutants at their source.

The report has shown that the pretreatment program has been an effective means of reducing the discharge of many hazardous constituents to POTWs. At the same time, the report has identified areas where information is lacking and areas where further actions could take place to remove additional hazardous constituents from POTWs.

In the absence of the DSE, RCRA waste management requirements would be layered on top of CWA provisions for control of hazardous waste discharges to sewers and would impose a variety of additional requirements on POTWs. This action would require an integration of both programs. It is unclear if the final integrated program would be substantively different that the existing pretreatment program with improvements as called for in this report.

For these reasons, this study recommends the retention of the DSE at the present time and identifies areas where the pretreatment program should be improved to control hazardous waste discharges to sewers. In addition, the report describes where information is lacking. If future studies indicate that further controls are needed to address potential problems such as air and ground water releases at IUs and POTWs, it would then be appropriate to reconsider whether modification or elimination of the DSE is required to implement such controls.

6.4.2 The Effectiveness of CWA Pretreatment Controls

The rationale for the DSE is that pretreatment controls on hazardous waste discharges will ensure protection to the POTW and receiving environments. In essence, technology-based and water quality-based standards and local limits developed by EPA and POTW wastewater treatment experts under the auspices of the pretreatment program should lead to treatment by IUs/generators prior to discharge to sewers. The proximity of municipal control authorities to discharging industries, along with the wide range of compliance tools available in Federally approved local programs (industrial inventories, inspection, permitting, local limits, reporting, etc.) affords a unique opportunity for direct, site-specific control of hazardous discharges. Conceptually, this seems to be a very logical way of ensuring effective treatment of hazardous wastes. Section 6.2.4 and 6.3 of this chapter have provided an indepth explanation and evaluation of the design and implementation of pretreatment controls for control of DSE wastes. Summary observations include:

- The substantive pretreatment standards (categorical standards and general and specific prohibitions) are direct mechanisms for National regulation of industrial discharges to sewers.

- Currently, categorical standards do not cover all industries or pollutants of concern to the RCRA program.

- Categorical pretreatment standards have mainly been targeted at metals and are predicted to bring about significant reductions in the discharge of toxic/hazardous wastes from industries such as the electroplating and metal finishing industries. Standards for the largest organic discharger, the organic chemicals industry, are to be promulgated in the year 1986. These standards should address metals and organic pollutants, including volatile organics.

- Categorical standards have not regulated major toxic organic discharges of pollutants such as methylene chloride, 1,1,1-trichloroethane, toluene, and ethyl benzene. Major industrial sources of these unregulated pollutants include the Pharmaceuticals, Equipment Manufacturers, and Petroleum Refining industries. EPA has announced its plans to reexamine the need for additional pretreatment standards for the Pharmaceutical industry (50 FR 36638; September 9, 1985).

- The general and specific pretreatment prohibitions can be effective tools for limiting characteristic hazardous waste discharges to sewers. For example, pH restrictions may effectively control the discharge of acidic hazardous wastes and interference prohibitions may limit reactive wastes. Other prohibitions (e.g., against explosions) may warrant better definition.

- Possible expansion of the definitions of interference and pass through in the General Pretreatment Regulations to cover air emissions and/or ground water releases may improve pretreatment controls for volatilization or ground water contamination.

- Local limits can be well-placed to control the impacts of other hazardous wastes on a site-specific basis to supplement categorical standards and the prohibitions. Some cities have used them effectively, particularly for metals. Widespread development of local limits for toxic and hazardous organic compounds will require greater resources for sampling, analysis, and systems evaluation, and greater technical assistance.

- Key regulatory procedures, inherent in local pretreatment programs are effective tools for hazardous waste discharge regulation. Source identification, permitting, sampling and analysis, inspections, and enforcement and oversight activities by POTWs provide mechanisms for

DSE waste control. POTWs may also be ideally suited to assist with regulation of small quantity generators.

- Pretreatment procedures need to be extended to cover all sources of hazardous wastes to POTWs. For example, joint inspections by State or Federal RCRA and pretreatment officials could supplement existing resources and provide better integration of controls.

- In particular, EPA has not yet implemented Section 3018(d) of RCRA. Consequently, generators are not yet providing information under this Section. Further, the RCRA amendments never envisioned that POTWs would receive these data, and therefore POTWs are left out of RCRA's paperwork trail even though they may receive hazardous waste.

- Sections 3004(m) and (n) of RCRA, which address land disposal ban and air emission controls respectively, might additionally serve as potential mechanisms for controlling industrial user discharges.

- The effectiveness of the existing program and the implementation of additional controls for hazardous waste depend on additional local, State, and Federal resources.

- Additional controls for spills and liquid waste haulers are needed under the pretreatment program to ensure identification and adequate control of these sources.

On balance, pretreatment programs have controlled substantial amounts of hazardous constituents, and pretreatment authorities, with some adjustments, seem well-designed to control the known impacts of DSE wastes. Existing tools should be employed to deal with the full range of sources and wastes which are or will be discharged.

6.4.3 Appropriateness Of Other RCRA/CWA Controls On POTWs Receiving Hazardous Wastes and the Environment

The majority of Chapter 6 has dealt with the domestic sewage exclusion and the effectiveness of Federal and local pretreatment controls in regulating resultant hazardous discharges. A directly related issue is the adequacy of CWA/RCRA regulation of POTWs which are the recipients of hazardous wastes. Resolution of this issue requires consideration, on the one hand, of RCRA's TSDF requirements, and in particular, the permit-by-rule and corrective action provisions. On the other hand, pertinent water controls include municipal NPDES permitting, pretreatment controls, and municipal sludge management requirements.

RCRA TSDF provisions currently regulate POTWs differently depending on how they receive hazardous wastes. If a plant receives hazardous waste as a DSE waste in a domestic sewer pipe, then the POTW is not automatically considered a TSDF. If a POTW receives the same waste by truck, rail, or dedicated pipe, the POTW is subject to RCRA permit-by-rule provisions including corrective action. All of these wastes, including those received by truck must comply with applicable pretreatment standards. This differential regulatory approach, based solely on the mode by which the waste is received, may not be justified on an environmental basis. The more appropriate approach would consider whether specific hazardous wastes are causing environmental effects at the POTW or on the receiving environment. Additional study is needed to determine whether there are POTWs with site specific problems associated with hazardous waste that require consideration of additional controls. It appears that few, if any, POTWs are currently knowingly receiving manifested hazardous wastes.

One obvious finding that may guide the development of additional RCRA controls is the fact that CWA controls are appropriate for limiting surface water and sludge-related impacts from POTWs, but only have an indirect ability to control air or groundwater releases from POTWs receiving hazardous wastes. On the other hand, RCRA authorities are sufficiently broad to permit control of ground water and air releases from TSDFs.

Alternatively, other statutes might be invoked to control these releases. For example, VOC regulation under the Clean Air Act might be expanded to cover releases from POTWs. EPA's Office of Air Quality Planning and Standards is currently developing an air emissions regulation for TSDFs. POTWs receiving hazardous wastes could conceivably be covered under this regulation.

Other statutes (e.g., OSHA, CERCLA) may have some utility in controlling the deleterious effects associated with DSE discharges and releases from POTWs. For example, CERCLA reportable quantity provisions for spill reporting may assist in regulation of spills to POTWs once the issue of Federally permitted releases is resolved. Either CERCLA or RCRA authorities may be employed as additional enforcement authorities where problems have occurred as a result of illegal dumping. In addition, RCRA 3004(m) and (n) authorities are also potential mechanisms for improving pretreatment source controls on industrial users.

In trying to resolve the issue of POTW as TSDF, it became apparent that the status of a POTW as a regulated party under RCRA was unclear to municipalities as well as State and Federal hazardous waste regulators. An evaluation of HWDMS data on POTW notifications indicated confusion among all parties. Hence, clarification in regulations or guidance should be a significant step in ensuring that POTWs receive appropriate attention should they assume the role of hazardous waste treater.

As a final point, it should be noted that recent changes to RCRA -- restrictions on land disposal and expansion of coverage of small quantity generators especially -- will probably increase industrial use of the domestic sewage exclusion to dispose of hazardous wastes. At the same time, the HSWA extended notification requirements to DSE dischargers, and water and sludge standards and control techniques are being developed to enhance toxics regulation in the Nation's water program. Improvements under the CWA and RCRA should facilitate control of these expected increased discharges.

CHAPTER 7

FINDINGS AND RECOMMENDATIONS

7. FINDINGS AND RECOMMENDATIONS

7.1 INTRODUCTION

In preceding chapters, EPA identified and characterized sources, types, and quantities of hazardous wastes discharged to POTWs, and examined the fate and effects of these wastes once discharged to public sewers. Moreover, the study discussed and evaluated existing statutory, regulatory, and programmatic authorities to control hazardous waste discharges to POTWs. This chapter summarizes the findings of the Domestic Sewage Study in the following three areas:

- Sources, types, and quantities of hazardous wastes currently discharged to POTWs
- Fate of hazardous waste discharges within POTW collection and treatment systems, and potential effects of these wastes on POTW operations, human health, and the environment
- Adequacy of existing controls on the discharge of hazardous wastes.

This chapter also presents a set of recommendations identifying technical, regulatory, and administrative issues which warrant further attention.

7.2 FINDINGS

In performing its source evaluation, EPA collected information on waste discharges from 47 industrial categories and the residential sector. The DSS analysis provides detailed loadings estimates for 30 selected consent decree industries. EPA presently does not have sufficient data to characterize fully waste discharges by the remaining 17 industrial categories, although it appears, based on limited available data, that certain of these categories may be discharging significant quantities of waste.

After assessing the various data sources available for performance of the DSS, EPA adopted a technical approach that provides estimates for loadings of specific hazardous constituents (e.g., benzene, tetrachloroethylene, acetone, etc.) rather than generic RCRA waste types (e.g., spent solvents, electroplating baths, still bottoms, etc.). The Agency collected and evaluated discharge data for 165 selected hazardous constituents. Because of data limitations, the analysis provides more extensive estimates for loadings of priority hazardous constituents (i.e., CWA priority pollutants) rather than nonpriority hazardous constituents. More comprehensive assessment of hazardous waste discharges, then, is heavily dependent on the collection of additional data on discharges of generic RCRA waste types and nonpriority hazardous constituents to POTWs. Evaluation of the fate and effects of hazardous waste discharges in POTWs is similarly hindered by the limitations on existing technical data for specific constituents, especially nonpriority constituents.

- Findings on Sources, Types, and Quantities of Hazardous Constituents Discharged to Sewers

  The DSS source assessment evaluated discharge data for 47 industrial categories and the residential sector and identified approximately 160,000 industrial and commercial facilities discharging wastes that contain the hazardous constituents. Together, these facilities discharge an estimated 3,200 mgd of process wastewater, constituting approximately 12 percent of total POTW flow. The 30 selected consent decree industries discharge 62,000 metric tons per year of the hazardous metal constituents at raw discharge levels, and 3,300 metric tons per year of the hazardous metal constituents, assuming full PSES reductions. With full implementation and enforcement, categorical standards should produce a 94 percent reduction in metal constituent loadings from the consent decree industries.

  These same industries discharge between 37,000 and 52,000 metric tons per year of the priority organic constituents at raw discharge levels, and approximately 20,000 metric tons per year of these constituents, assuming implementation of existing and proposed PSES standards. At projected PSES control levels, categorical standards will provide reductions in organic constituent loadings of between 47 and 60 percent. Relative contributions of metal and priority organic constituents from the residential sector will increase significantly following PSES implementation.

  - Discharge of Characteristic Wastes to POTWs

    Significant quantities of ignitable, corrosive, and reactive hazardous wastes are discharged to POTWs. POTW operational problems, including sewer line corrosion, actual or threatened explosions and generation of toxic fumes, which may result from these discharges, have been documented. A review of categorical standards, prohibited discharge standards, and selected POTW ordinances demonstrates that existing pretreatment standards may not adequately control the discharge of certain types of characteristic wastes. For other waste types, regulatory controls are already adequate, indicating a need instead for more aggressive enforcement and additional spill control measures to minimize these discharges.

- Discharge of Hazardous Metals/Cyanide to POTWs

  The consent decree industries discharge approximately 62,000 metric tons per year of hazardous metals and cyanide to POTWs under a raw loadings scenario. The electroplating/metal finishing industry accounts for 68 percent of total raw loadings. Other major metals/cyanide sources include the organic chemicals, leather tanning, pharmaceuticals, iron and steel, battery, and inorganic chemicals industries. Other possible sources include motor vehicle operations and service-related industries.

  The Chapter 3 industry assessment projects a 94 percent reduction in metals/cyanide loadings from consent decree industries under the PSES scenario. Accordingly, full PSES implementation should provide substantial controls on hazardous metals (including EP toxic metals) and cyanide discharges from known major sources. Nonetheless, pretreatment program data indicate that as many as 30 percent of all electroplating/metal finishing firms have not complied yet with categorical standards for electroplaters/metal finishers. Consequently, aggressive enforcement of metal finishing and other categorical standards will be necessary to ensure full control of metals/cyanide discharges under existing categorical standards.

- Discharge of Priority Organic Constituents to POTWs

  The consent decree industries discharge between 37,000 and 52,000 metric tons per year of priority organic constituents under a raw loadings scenario. Major priority organics sources include the organic chemicals, plastics, resins and synthetic fibers, equipment manufacturing, pharmaceuticals, electroplating/metal finishing, iron and steel, petroleum refining, laundries, and pesticide manufacturing industries. A number of other possible industrial sources also were identified, including hazardous waste treatment facilities, wood refinishers, and laboratories.

  An evaluation of organics discharge data demonstrates the importance of current PSES rulemakings for the organic chemicals and pesticide industries in controlling major organics sources. Assuming full implementation of the proposed OCPSF standard and the recently promulgated pesticide manufacturing standards, overall PSES implementation will result in an estimated 47 to 60 percent reduction in priority organics loadings to POTWs from consent decree industries. Nonetheless, other significant organics sources, such as pharmaceuticals, equipment manufacturing, laundry, and petroleum refining industries are not controlled currently at the Federal level under existing categorical standards.

- Discharge of Nonpriority RCRA Constituents to POTWs

  EPA currently lacks the data necessary to estimate loadings of nonpriority RCRA constituents from most industrial categories. Still, the Industry Studies Data Base contains substantial nonpriority constituent data for the four organic chemicals industrial categories. Based on ISDB, raw loadings to POTWs of nonpriority hazardous constituents are estimated to be approximately 64,000 metric tons per year, of which only 736 metric tons constitute nonpriority metals. This analysis indicates that the major organics industries discharge approximately 2.5 kilograms of nonpriority constituents for each kilogram of priority constituents. Information collected from a variety of data sources suggests that nonpriority constituents also are discharged in significant quantities by numerous other industries. Even if extensive loadings information existed, there is a lack of technical data necessary to determine fate and effects of these compounds. Before EPA can effectively regulate any of these compounds, it will be necessary to improve our knowledge of the sources, quantities, and impacts of these constituents.

- Discharge of Solvents and Other Common Organics to POTWs

  Certain priority organics, especially chlorinated solvents, aromatic hydrocarbons, and phthalate esters, frequently are detected in POTW influent wastewaters. Nonpriority organic solvents, such as xylene, methyl ethyl ketone, acetone, ethyl acetate, methanol, and others also are projected to be common constituents of POTW wastewaters. The prevalence of these organic compounds in POTW wastewater raises concerns about potential effects on human health, the environment, and POTW operations when discharged to sewers.

  Solvents may be discharged by a broad range of industrial categories. Consequently, any regulatory strategy to develop and implement solvent controls must adequately reflect the number and variety of possible sources of solvent wastes.

- Discharge of Wastes to POTWs by Small Quantity Generators

  Data from the Small Quantity Generator Data Base demonstrate that small quantity generators discharge wastes containing hazardous constituents to POTWs. Data were not available to quantify loadings of hazardous constituents in these wastes. Major SQG sources include motor vehicle operations, service-related industries, wood refinishers, laundries, printing/publishing operations, laboratories/hospitals, and construction firms. Major waste types include spent solvents, ignitable waste, acid/alkaline wastes, photographic wastes, formaldehyde wastes, and pesticide wastes. Stringent regulation of SQG wastes under the RCRA program may result in the increased discharge of these wastes to POTWs as an alternative to land disposal and other restricted disposal methods. Due to the large number of SQG facilities discharging to POTWs, implementation of pretreatment controls on the discharge of SQG wastes may require the commitment of substantial programmatic resources at the Federal, State, and POTW levels.

- Discharges By Hazardous Waste Management Facilities

  Limited data exist on discharges to POTWs by the range of hazardous waste management facilities. Sources include hazardous waste site cleanups (e.g., CERCLA, State, local, and private cleanups), transportation (e.g., tank/truck cleaning, drum/barrel reconditioning, liquid waste haulers), waste reclamation (e.g., waste oil recyclers, solvent reclaimers, battery salvagers), and waste treatment and disposal industries (e.g., landfills, surface impoundments, centralized waste treatment facilities). Many of these new discharge sources stem from hazardous waste cleanups under CERCLA and parallel State statutes and from implementation of RCRA programs requiring the development of waste management capacity necessary to recycle, transport, treat, store, or dispose of hazardous wastes. Data collected for the industry assessment demonstrate that these facilities are discharging wastewaters to POTWs and, in some instances, causing operational problems at POTWs.

- Spills/Slug Loads of Hazardous Waste to POTWs

  Spills to sewage treatment plants do occur and may cause major operational problems at these facilities. In the AMSA survey, approximately 60 percent of POTW respondents indicated that they received hazardous wastes as a result of spills to public sewers. Also, over 50 percent reported receiving batch discharges of hazardous waste from connected industries. As documented by POTW incidents data, these discharges may be the cause of a variety of POTW operational problems, including worker illness, actual or threatened explosion, biological upset/inhibition, toxic fumes, corrosion, and contamination of sludge and receiving waters. Presently, Federal pretreatment regulations require slug load notification by industries, but do not require POTWs or industries to implement spill prevention and containment controls. Although some POTWs have adopted storage and spill control measures, others are poorly prepared to cope with spills and slug load discharges of hazardous wastes from industries.

- Discharges by Liquid Waste Haulers to POTWs

  Liquid waste haulers are also a source of hazardous waste discharges to POTWs. Thirty-two percent of POTW respondents in the AMSA survey reported receiving hazardous waste discharges from septage haulers, while 23 percent of the respondents reported hazardous waste discharges from other liquid waste haulers. Followup discussions with AMSA respondents reporting the receipt of hazardous wastes from these sources have indicated that none of these POTWs actually receive RCRA-manifested hazardous wastes, but that many of these POTWs are concerned about possible undetected discharges by haulers of hazardous wastes mixed with septage wastes and other nonhazardous liquid wastes. Approximately 40 percent of the AMSA respondents cited illegal discharges by midnight dumping sources, some of which are likely to be liquid waste haulers discharging surreptitiously to public sewers. Review of POTW and industrial data confirms that liquid waste haulers, including midnight dumpers, frequently utilize public sewers for waste disposal.

Presently, Federal pretreatment standards regulate the discharge of industrial wastes by liquid waste haulers. As indicated in the AMSA Survey, some POTWs already have instituted local controls, such as permits/agreements, manifesting requirements, designated manholes, and sampling programs for discharges by liquid waste haulers. Control of hazardous waste discharges by midnight dumpers will rely heavily on the integrity of the RCRA manifest system and efficacy of enforcement by Federal, State, and local officials.

- Evaluation of the Fate and Effects of DSE Wastes

The analysis of the fate and effects of DSS pollutant discharges to POTWs shows clearly that environmental degradation can occur as a result of these discharges. However, quantitative estimates of these effects are hampered by a lack of environmental criteria and a lack of available data on these effects. There are four significant pollutant fates within POTW treatment systems -- air-stripping, adsorption to sludge, biodegradation, and pass through to receiving waters. An estimated total annual loading of 92 million kilograms of hazardous pollutants enter POTWs nationwide. While these loadings are important, an analysis of effects on sludge and water quality shows that the significant effects are associated with the toxicity and characteristics of the specific pollutants and not just the quantities of hazardous pollutants entering the environment. The following items elucidate these overall conclusions:

  - Pollutant Fate Within POTW Treatment Systems

Assuming a fully acclimated biological treatment system, EPA estimates that 92 percent of all pollutants are removed by POTWs from discharges to surface waters. Under this scenario, 14 percent of all pollutants are air-stripped, 16 percent are removed to sludge, 62 percent are biodegraded, while 8 percent pass through to receiving waters. Assuming unacclimated POTW treatment, an estimated 82 percent of all pollutants are removed by POTWs from discharges to surface waters. Under this second scenario, 25 percent of all pollutants are air-stripped, 14 percent are removed to sludge, 43 percent are biodegraded, while 18 percent pass through to receiving waters. As indicated by these projections, the degree of biological acclimation in POTW treatment units may significantly affect overall POTW removal efficiencies, as well as pollutant fate within treatment systems. Generally, as system acclimation decreases, POTW removal efficiencies tend to decrease, while pollutant quantities air-stripped tend to increase due to reductions in competing processes such as biodegradation. Without additional information on wastewater discharge patterns and biological acclimation rates, EPA cannot at this time determine which treatment scenario is more representative of actual treatment conditions at POTWs accepting industrial wastewater.

- Potential Water Quality Effects of POTW Dischargers

  Water quality analyses conducted by EPA and two States predict that POTW effluent discharges may have adverse water quality impacts. The Chapter 5 dilution modeling analysis, comparing in-stream concentrations of POTW effluent to EPA water quality criteria, projects exceedances of water quality criteria for human health and aquatic life. Moreover, bioassay studies conducted by EPA Region V and the States of Florida and North Carolina document the toxic and mutagenic properties of some POTW effluents containing industrial wastewaters. The need for protection of drinking water quality is underscored by an EPA analysis, which has identified a total of 529 drinking water treatment facilities downstream of pretreatment POTWs, and 130 facilities (25 percent of this total) within 5 miles downstream of a pretreatment POTW outfall.

- Ambient Air Quality Effects of POTW Emissions

  EPA estimates that between 12.9 and 23.2 million kilograms per year of volatile pollutants are emitted by POTWs to ambient air. Ten volatile pollutants are projected to account for over 90 percent of total emissions. POTW emission of volatile organics has been confirmed by EPA through ambient monitoring at Philadelphia and other POTWs.

  POTW VOC emissions appear to represent a small contribution nationally to ozone formation in ambient air. While the significance of this contribution is unknown, EPA currently is considering controlling even small VOC sources in nonattainment areas. EPA has identified 173 pretreatment POTWs located in ozone nonattainment areas. POTWs also may emit significant quantities of air toxics as a result of industrial discharges to POTWs. Nine of the 10 pollutants estimated to be emitted in the largest quantities by POTWs have been or are being considered by EPA for regulation as hazardous pollutants under the Clean Air Act. Comprehensive evaluation of health effects of these and other volatile pollutants is hampered substantially by difficulties in measuring emissions for POTWs, limited understanding of pollutant fate in ambient air, and lack of human health criteria for exposures to toxics in the ambient air environment.

- Environmental Effects of Sewage Sludge Disposal

  The study indicates that between 14 and 16 percent of all DSS constituents are removed to sewage sludge. Metal hazardous constituents constitute 59 percent of this total. Based on Agency technical work supporting the development of technical criteria under CWA §405, major pollutants of concern for landfilling and land application of sewage sludge include metals (e.g., arsenic, cadmium, mercury, chromium, and nickel), PCBs, and chlorinated pesticides. Because POTW sewage sludges rarely fail the EP toxicity test for RCRA hazardous wastes, these sludges generally are regulated under RCRA Subtitle D and CWA §405, as well as State and local laws.

- Ground Water Contamination Due to Leaks from POTW Collection and Treatment Systems

  To date, there are few data indicating whether leaks from POTW collection, treatment, and residuals disposal systems have caused ground water contamination. As a result, conclusions on the extent of ground water contamination due to POTW releases must await further technical evaluation of POTW operational characteristics as they relate to ground water. In response to Section 3018(c) of HSWA of 1984, EPA currently is examining the effects of municipal wastewater treatment lagoons on ground water. This study, however, will not consider ground water impacts of other possible POTW sources, such as exfiltration from collection systems.

- Adequacy of Existing Government Controls on the Discharge of Hazardous Wastes to Sewers

Substantial amounts of hazardous waste constituents have been regulated and sufficient authorities exist under the CWA and RCRA to control the known impacts associated with the discharge of hazardous wastes to sewers. This finding supports retention of the DSE at the present time, recognizing the logic of RCRA's reliance on the CWA's pretreatment program for regulation of the discharge of aqueous hazardous wastes to sewers. At the same time, deficiencies exist in Federal pretreatment standards and weaknesses in local pretreatment programs that could be improved, under existing authorities, to better protect human health and the environment.

A basic lack of information on releases of hazardous waste to ground water and air from POTWs requires that further study be undertaken prior to completion of the assessment of the need for additional regulatory controls. These potential impacts may require increased reliance on RCRA and/or other statutes to fill gaps in protection afforded by provisions of the CWA.

- Retention of the Domestic Sewage Exclusion

  The DSE provides continuity between the regulatory controls imposed by RCRA and the CWA. RCRA rules do not apply to hazardous wastes upon "first entry" to the sewer system. Once hazardous wastes enter the sewer system, CWA's pretreatment program becomes the sole applicable control program. From a regulatory standpoint, CWA authorities can work as an effective mechanism to control hazardous waste discharges to sewer systems. On a practical level, however, CWA controls have not been employed to the extent possible to regulate organic priority pollutants and nonpriority pollutants. Nonetheless, sufficient latitude exists within the statutory framework to develop regulations and guidance that can result in more extensive control of these pollutants. RCRA authorities may also afford a mechanism to provide additional pretreatment controls on industrial users.

The Clean Water Act may not have sufficient authorities to take actions to remediate potential air emission and ground water contamination incidents which might be associated with the discharges of these wastes to POTWs. Authorities under other statutes (e.g., RCRA, CAA, CERCLA) may be appropriate as corrective tools if these incidents prove to warrant attention.

- Effectiveness of Categorical Pretreatment

The implementation of categorical standards can result in substantial reduction of pollutants discharged. The effectiveness of the categorical pretreatment program has been restricted by: (1) the industries regulated under the program; and (2) the pollutants covered by available standards. The findings of this study demonstrate the need to consider the development of categorical standards for additional industries (e.g., paint and ink formulation, printing and publishing, laundries, emerging hazardous waste service industries such as solvent reclaimers). The findings also demonstrate that currently promulgated, or soon to be promulgated, regulations for the metal finishing, pharmaceutical, and organics industries do not specifically regulate nonpriority organics, despite the fact that many of these pollutants are discharged in significant concentrations and/or loadings.

- Effectiveness of Local Pretreatment

Nearly 1,500 POTWs are required to develop and implement local pretreatment programs under the General Pretreatment Regulations to ensure the protection of POTW operations, the receiving environment, and worker health and safety. The general and specific prohibition requirements of the regulations provide significant latitude for POTWs to control the discharge of DSS pollutants. However, due to a variety of factors, including a lack of information on pollutant sources, technical guidance, and uneven program implementation, including compliance activities, these requirements have not worked to their fullest capacity to limit the discharge of DSS pollutants. Improved technical guidance on the sources of DSS pollutants, and available treatment mechanisms, can enhance POTW control of these pollutants. In addition, an increased number of environmental criteria and standards for surface water and sludges can assist the POTW in designing appropriate local limits.

Administrative mechanisms available in Federally approved local programs (e.g., industrial surveys, permitting, reporting requirements, inspections) should provide excellent vehicles for controlling hazardous waste discharges. POTWs are well-positioned to assist with the regulation of SQGs. The effectiveness of the existing program and implementation of additional controls for hazardous wastes depend on additional Federal, State, and local resources.

- Coordination of RCRA/CWA Activities

  Several recent hazardous waste management developments should affect the types, sources and amounts of hazardous wastes being discharged to sewers. These include new restrictions on land disposal, extension of RCRA requirements to more SQGs, the closing of disposal facilities due to loss of interim status, and implementation of corrective action requirements. While only a small percentage of hazardous wastes currently are discharged to sewers, reductions in disposal capacity as a result of the above changes potentially will cause an increase in the use of sewers for waste disposal. The Office of Solid Waste and the Office of Water will need to coordinate regulatory efforts to ensure that these increases do not harm POTW operations, human health, or the environment.

  Coordination of future RCRA activities should include source identification and waste listing/regulation. Coordination of hazardous waste generator notification requirements under Section 3018(d) of RCRA is needed to ensure proper handling of information collected from industries discharging hazardous waste to sewers.

7.3 RECOMMENDATIONS

The following four recommendations for improving control of discharges of hazardous wastes to sewers have been derived from the findings of the Domestic Sewage Study:

- Additional research, data collection, and analysis is necessary to fill information gaps on sources and quantities of hazardous wastes, their fate and effects in POTW systems and the environment, and the design of any additional regulatory controls which might be necessary.
- Improvements can be made to Federal categorical standards and local pretreatment controls to enhance control of hazardous wastes discharged to sewers.
- EPA should emphasize the improvement of controls on hazardous wastes through ongoing implementation of Water Programs. This will require coordination with the water quality program, sludge management program, and enforcement programs.
- RCRA, CERCLA, and the CAA should be considered along with CWA to control hazardous waste discharges and/or receiving POTWs if the recommended research indicates the presence of problems.

These recommendations are elucidated by the section below which provides additional detail on areas potentially deserving attention under each recommendation. Some items identified overlap others. Thus, choices will need to be made before a final regulatory agenda is set to meet Section 3018(b) of the RCRA amendments. Nonetheless, these lists present a broad range of additional activities which EPA may consider as means for improving hazardous waste controls. All recommendations are contingent upon Agency priorities and the availability of resources at the Federal, State, and local levels.

- Research and Data Collection and Analysis to Fill Informational Gaps
  - Development and refinement of sampling/analytical protocols and standards for nonpriority pollutants
  - Evaluation of sources and control of RCRA solvents discharged to POTWs
  - Assessment of incidence and effects of midnight dumping into sewers
  - Development and refinement of techniques for monitoring air releases from POTWs, and collection of data on emissions of VOCs and air toxics from POTWs
  - Continuation of research on pollutant fate within POTW collection and treatment systems, including examination of effects of biological acclimation on POTW removal efficiencies and pollutant fate
  - Continuation of research on the effects (human health and environment) of the discharge of hazardous constituents to POTWs
  - Assessment of possible POTW sources of ground water contamination including exfiltration from sewers and contamination due to leachates from landfills handling sewage sludges
  - Development of additional water quality and sludge criteria for RCRA constituents, especially for nonpriority constituents

- Improvement of Pretreatment Standards
  - Inclusion of selected RCRA constituents on CWA priority pollutant list or adoption of equivalent approach for regulation of these constituents
  - Modification of categorical standards for existing consent decree industries to improve control of organic priority constituents and nonpriority constituents

- Promulgation of categorical standards for industrial categories not included in NRDC consent decree
- Modification of prohibited discharge standards to improve control of characteristic hazardous wastes and solvents

- Emphasis on Ongoing Water Program Implementation Efforts
  - Expansion of pretreatment controls on spills and batch discharges of DSE wastes
  - Implementation of RCRA Section 3018(d) notification requirements for industries discharging hazardous wastes to POTWs
  - Improvement of controls on discharges by liquid waste haulers, including stronger enforcement against illegal discharges by midnight dumpers
  - Improvement/implementation of local limits at the POTW level on the discharge of organics
  - Stringent enforcement of existing PSES standards
  - Expanded use of biomonitoring techniques and water quality-based permitting to improve protection of receiving waters
  - Continued development and implementation of technical criteria for use/disposal of sewage sludge

- Identification and Application of Other Environmental Controls
  - Evaluation and implementation of VOC, NESHAPS and State air toxics controls for POTWs emissions including consideration of controls on industrial discharges which result in POTW emissions.
  - Evaluation of alternative regulatory control programs (RCRA, CERCLA, CWA, and CAA) applied to POTWs if further studies and analysis show need for additional controls.

LIST OF REFERENCES

CHAPTER 1

LIST OF REFERENCES

1. Congressional Record, H 9150, daily edition: November 3, 1983.

CHAPTER 2

LIST OF REFERENCES

1. U.S. Congress, House of Representatives, Hearings before the Subcommittee on Investigations and Review of the Committee on Public Works and Transportation. Committee Print Number 95-32, pages 399-405.

2. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Paragraph 4(c) Program, Summary Report. Washington, DC: January 1984.

3. Based on types of data sources and other considerations, the DSS industrial categories were divided into "organics industries" and "nonorganics industries." Organics industries include the organic chemicals, dye/pigments, petroleum refining, rubber, and pesticide industries. Nonorganic industries include all remaining industrial categories. See Chapter 3 for a complete discussion of the DSS industry classification scheme.

CHAPTER 3

LIST OF REFERENCES

1. U.S. International Trade Commission, Synthetic Organic Chemicals: United States Production and Sales. Washington, DC: U.S. Government Printing Office, 1981, 1982, 1983.

2. Resource Conservation and Recovery Act, PL 96-463, October 15, 1980, 42 USC 6901.

3. Hazardous and Solid Waste Amendments of 1984, PL 98-616, November 8, 1984, 42 USC 6901 et. seq.

4. Abt Associates, Inc., National Small Quantity Hazardous Waste Generator Survey. Prepared for the U.S. Environmental Protection Agency, Office of Solid Waste, February 1985.

5. U.S. Environmental Protection Agency, Office of Solid Waste, National Small Quantity Hazardous Waste Generator Survey Data Base.

6. __________, Office of Water Regulations and Standards, Paragraph 4(c) Program, Summary Report. Washington, DC: U.S. Environmental Protection Agency, January 1984.

7. E.C. Jordan Co., EPA Food Industry Group Pretreatment Standards Evaluation for the Pharmaceutical Manufacturing Category. Prepared for the U.S. Environmental Protection Agency, Effluent Guidelines Division, August 1983.

8. U.S. Environmental Protection Agency, Effluent Guidelines Division, Development Document for Final Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Pharmaceutical Manufacturing Point Source Category. September 1983.

9. __________, Effluent Guidelines Division, Proposed Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category. EPA-440/1-82/091-b. August 1982.

10. Standard Research Institute, Chemical Economic Handbook. 1984.

11. Luh, Mike, Baltimore Department of Public Works, Memorandum to Doug Murtland, SAIC. September 25, 1985.

12. Dun's Marketing Service, Standard Industrial Classification Statistics. 1984.

13. U.S. Environmental Protection Agency, Effluent Guidelines Division, Development Document for Effluent Limitations Guidelines for New Source Performance Standards for the Basic Fertilizer Chemicals Segment of the Fertilizer Manufacturing Point Source Category. NTIS PB-238 652. March 1974.

14. Goldstein, Ken, New Jersey Department of Environmental Protection, Data submitted to SAIC. August 1985.

15. U.S. Environmental Protection Agency, Office of Public Affairs, *EPA Journal*, Vol. 11, Number 7, September 1985.

16. _________, Emergency and Remedial Response Information System.

17. Taft, James, Memorandum to Martha Prothro, Director, Permits Division. Subject: An Assessment of the Number of POTWs Covered by a RCRA Permit By Rule. September 12, 1985.

18. U.S. Environmental Protection Agency, *Summary Report: Remedial Response at Hazardous Waste Sites*. 1984.

19. _________, Office of Solid Waste, Hazardous Waste Damage Incident Data Base.

20. _________, Effluent Guidelines Division, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Soap and Detergent Manufacturing Point Source Category*. NTIS PB-238 613. April 1974.

21. _________, Effluent Guidelines Division, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Textile, Friction Materials and Sealing Devices Segment of the Asbestos Manufacturing Point Source Category*. NTIS PB-240 860. December 1974.

22. JRB Associates, *Investigation of New Industries*. Prepared for U.S. Environmental Protection Agency, Office of Analysis and Evaluation, October 19, 1984.

23. U.S. Environmental Protection Agency, *Source Assessment: Rail Tank Car, Tank Truck, and Drum Cleaning, State of the Art*. 1978.

24. Arthur D. Little, *Draft Economic Impact Analysis of Subtitle C; Resource Conservation and Recovery Act of 1976*. October 19, 1984.

25. *Philadelphia Inquirer*, "Despite Tougher Laws, Waste Haulers Find Loopholes," Sunday, November 27, 1983.

26. Kelleher, Joe, New York State Department of Environmental Protection, Data submitted to SAIC. September 1985.

27. Southern California Hazardous Waste Management Project, *Hazardous Waste Generation and Facility Development Needs in Southern California*. Revised Draft. February 1983.

28. JRB Associates, *Evaluation of RCRA Subtitle D Facilities*. Draft. Prepared for the U.S. Congress, Office of Technology Assessment, January 20, 1984.

29. U.S. Environmental Protection Agency, *Fate of Priority Pollutants in Publicly Owned Treatment Works*. Volumes I and II. EPA-440/1-82-303. September 1982.

30. __________, Office of Water Program Operations, *NEEDS Survey Report to Congress, User's Manual*. EPA-430/9-84-011. 1984.

31. __________, *Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants*. Volumes III and VI. June 1979.

CHAPTER 3

ADDITIONAL REFERENCES

U.S. Environmental Protection Agency, *Addendum: Assessment of the Impacts of Industrial Discharges on Publicly Owned Treatment Works*. February 25, 1983.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards Beet Sugar Processing Subcategory of the Sugar Processing Point Source Category*. NTIS PB-238 462. January 1974.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Dairy Product Processing Point Source Category*. NTIS PB-238 835. May 1974.

________, *Proposed Development Document for Effluent Limitations Guidelines and Standards for the Paint Formulating Point Source Category*. EPA-440/1-79-049-b. December 1979.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Grain Processing Segment of the Grain Mills Point Source Category*. NTIS PB-238 316. March 1974.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Building, Construction and Paper Segment of the Asbestos Manufacturing Point Source Category*. NTIS PB-238 320. February 1974.

________, *Final Development Document for Effluent Limitations Guidelines and Standards for the Aluminum Forming Point Source Category*. Volumes I and II. EPA-440/1-84-073. June 1984.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Renderer Segment of the Meat Products and Rendering Processing Point Source Category*. NTIS PB-253 572. January 1975.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Apple, Citrus and Potato Processing Segment of the Canned and Preserved Fruits and Vegetables Point Source Category*. NTIS PB-238 649. March 1974.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Fish Meal, Salmon, Bottom Fish, Clam, Oyster, Sardine, Scallop, Herring, and Abalone Segment of the Canned and Preserved Fish and Seafood Processing Industry Point Source Category*. NTIS PB-256 840. September 1975.

________, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Builders Paper and Roofing Felt Segment of the Builders Paper and Board Mills Point Source Category*. NTIS PB-238 076. May 1974.

__________, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Synthetic Resins Segment of the Plastics and Synthetic Materials Manufacturing Point Source Category. NTIS PB-239 241. March 1974.

__________, Proposed Development Document for Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundries) Point Source Category. Volumes I and II. EPA-440/1-82-070-b. November 1982.

__________, Proposed Development Document for Effluent Limitations Guidelines and Standards for the Ink Formulating Point Source Category. EPA-440/1-79-090-b. December 1979.

__________, Development Document for Expanded Best Practicable Control Technology, Best Conventional Pollutant Control Technology, Best Available Technology, New Source Performance Technology, and Pretreatment Technology, in the Pesticide Chemicals Industry. EPA-440/1-82-079-b; NTIS PB-83-153 171. November 1982.

__________, Draft Development Document for Effluent Guidelines and Standards for the Auto and Other Laundries Point Source Category. October 1980.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Phase II; Secondary Mercury Supplement. July 1984.

__________, Final Development Document for Effluent Limitations Guidelines New Source Performance Standards and Pretreatment Standards for the Petroleum Refining Point Source Category. NTIS PB-83-172569. October 1982.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Metallurgical Acid Plants Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Secondary Lead Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Columbium - Tantalum Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Copper Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Pharmaceutical Point Source Category. EPA-440/1-82-084. November 1982.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Antimony Supplement. July 1984.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category*. EPA-440/1-81-023. January 1981.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category*. May 1984.

________, *Development Document for Effluent Limitations Guidelines for the Electrical and Electronic Components Point Source Category*. Phase 2. December 1983.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Petroleum Refining Point Source Category*. EPA-440/1-79-014-b. December 1979.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Pulp, Paper, and Paperboard and the Builders' Paper and Board Mills Point Source Category*. EPA-440/1-82-025. October 1982.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Copper Forming*. EPA-440/1-84-074. March 1984.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category*. Phase II; Secondary Uranium Supplement. July 1984.

________, *Development Document for Effluent Limitations Guidelines and Standards for Battery Manufacturing Point Source Category*. Volumes I and II. EPA-440/1-84-067. August 1984.

________, *Development Document for Effluent Limitations Guidelines for the Electrical and Electronic Components Point Source Category*. Phase I. April 21, 1983.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Porcelain Enameling Point Source Category*. EPA-440/1-82-072. November 1982.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Leather Tanning and Finishing Point Source Category*. EPA-440/1-79-016. July 1979.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Leather Tanning and Finishing Point Source Category*. EPA-440/1-82-016. November 1982.

________, *Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category*. Secondary Aluminum Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Electroplating Point Source Category. EPA-440/1-79-003. August 1979.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Aluminum Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Lead Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Tungsten Supplement. May 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Gum and Wood Chemicals Manufacturing Point Source Category. EPA-440/1-79-078-b. December 1979.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Foundries (Metal Molding and Casting) Point Source Category. EPA-440/1-80-070-a. April 1980.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Precious Metals and Mercury Supplement. July 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Inorganic Chemicals Manufacturing Point Source Category. EPA-440/1-80-007-b. June 1980.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Phase II; Bauxite Refining Supplement. July 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Phase II; Primary and Secondary Titanium Supplement. July 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Phase II; Secondary Nickel Supplement. July 1984.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Photographic Equipment and Supplies Segment of the Photographic Point Source Category. EPA-440/1-80-077-a. May 1980.

__________, Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. Primary Zinc Supplement. May 1984.

__________, Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Explosives Manufacturing Point Source Category. EPA-440/1-76-060-j. March 1976.

__________, Development Document for Proposed Effluent Limitations Guidelines and Standards for the Shipbuilding and Repair Point Source Category. EPA-440/1-79-076-b. December 1979.

Dun's Marketing Service, Standard Industrial Classification Statistics. 1984.

E.C. Jordan Co, Priority Pollutants in Publicly Owned Treatment Works - Summary Report. Draft. Prepared for U.S. Environmental Protection Agency, Industrial Technology Division, April 1985.

U.S. Environmental Protection Agency, Fate of Priority Pollutants in Publicly Owned Treatment Works. Interim Report. EPA-440/1-80-301. Washington, DC: U.S. Environmental Protection Agency, October 1980.

Federal Register, Vol. 50, No. 137, p. 29068, July 17, 1985. Proposed Rule: Organic Chemicals and Plastics and Synthetic Fibers; Point Source Category Effluent Limitations Guidelines Pretreatment Standards; and Standards of Performance for New Sources.

Federal Register, Vol. 49, No. 247, p. 49784, December 21, 1984. Proposed Rule: Hazardous Waste Management System; Identification and Listing of Hazardous Waste.

Franklin Associates, Industrial Resource Recovery Practices Petroleum Refineries and Related Industries (SIC 29). Final Report. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, January 1983.

U.S. Environmental Protection Agency, Guideline Documentation for the Control of Water Pollution in the Photographic Processing Industry. EPA-440/1-81-082-9. April 1981.

JRB Associates, Industrial Resource Recovery Practices: Leather and Leather Products (SIC 31). Prepared for U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, February 1982.

Franklin Associates, Industrial Resource Recovery Practices: Petroleum Refineries and Related Industries (SIC 29). Draft Final Report. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, June 15, 1982.

__________, Industrial Resource Recovery Practices: Textile Mill Products Industries (SIC 22). Draft Final Report. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, June 1982.

Goldstein, Ken, New Jersey Department of Natural Resources, Industry Studies - Small Generator Studies. Prepared for Joe Kelleher or Max Goldman, N.Y. State Department of Environmental Conservation.

JRB Associates, 308 Questionnaire Data Base for the Establishment of Effluent Guidelines for the Organic Chemicals, Plastics and Synthetic Fibers Industrial Point Source Category. Prepared for U.S. Environmental Protection Agency, Effluent Guidelines Division, Office of Water Regulations and Standards, 1983.

JRB Associates, Industrial Technology Division Pesticides Data Base. Prepared for U.S. Environmental Protection Agency, Office of Water Regulations and Standards, 1985.

JRB Associates, Industry Studies Data Base. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, Waste Identification Branch, 1985.

JRB Associates, JRB Hazard Classification System for Waste Constituents. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, January 22, 1985.

Abt Associates, National Small Quantity Hazardous Waste Generator Survey. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, February 1985.

U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Organic Solvent Cleaner Background Information for Proposed Standards. EPA-450/2-78-045a. October 1979.

Pope-Reid Associates, Inc., Assessment of the Fate of SQG Hazardous Wastes in POTWs. Draft Final Report. Prepared for U.S. Environmental Protection Agency, Office of Policy Analysis, July 1985.

PEI Associates, Inc., Primary Lead Smelting and Refining Industry. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Industrial Environmental Research Laboratory, Cincinnati, Ohio, November 1984.

U.S. Environmental Protection Agency, Region II, Technical Assistance to Gloversville Johnstown, and Fulton County, NY in the Analysis of Alternatives for Tannery and Other Industrial Waste Management. Technical Assistance Panels Program Report. Contract No. 68-01-4893 and 68-01-6002.

Office of Management and Budget, Statistical Policy Division, Standard Industrial Classification Manual. 1972.

U.S. Environmental Protection Agency, Effluent Guidelines Division, Summary of Available Information on the Levels and Control of Toxic Pollutants Discharges in the Printing and Publishing Point Source Category. EPA-440/1-83/400. October 1983.

________, Supplement for Pretreatment to the Development Document for the Inorganic Chemicals Manufacture Point Source Category. EPA-440/1-77/087A. July 1977.

Camp Dresser and McKee Inc., The Wastewater Treatment Exemption. Prepared for the U.S. Environmental Protection Agency, Waste Management and Economics Division, September 30, 1984.

U.S. Environmental Protection Agency, Treatability Studies for the Inorganic Chemicals Manufacture Point Source Category. EPA-440/1-80/103. July 1980.

________, Office of Solid Waste, Hazardous Waste Data Management System.

________, Office of Water Regulations and Standards, Monitoring Data Support Division Data Base.

________, Office of Solid Waste, National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities (RIA Data Base).

________, Office of Water Regulations and Standards, Paragraph 4C Data Base.

________, Office of Water Regulations and Standards, Summary of Effluent Characteristics and Guidelines for Selected Industrial Point Source Categories. Industry Status Sheets: Volumes I and II. August 5, 1983 (Revised July 26, 1984).

Denit, Jeffrey, Director, Effluent Guidelines Division, Memo. Subject: Summary of the Effluent Guidelines Division Rulemakings Activities. September 1, 1984.

U.S. Environmental Protection Agency, Office of Solid Waste, National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981. EPA-530/SW-84-005. April 1984.

________, Final Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category. EPA-440/1-83/091. June 1983.

________, Final Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. Volumes I, II, III, IV, V, and VI. EPA-440/1-83/091. June 1983.

________, Final Development Document for Effluent Limitations Guidelines and Standards for the Coil Coating Point Source Category. EPA-440/1-82/071. October 1982.

Municipality of Metropolitan Seattle, Toxicant Pretreatment Planning Study, Water Quality Division. October 1984.

________, Proposed Development Document for Effluent Limitations Guidelines and Standards for the Plastics Molding and Forming Point Source Category. EPA-440/1-84/069-b. February 1984.

CHAPTER 4

LIST OF REFERENCES

1. Bishop, D.F., Memorandum to T.P. O'Farrell. Subject: Estimation of Removability and Impact of Priority 1 RCRA Toxics. May 22, 1985.

2. __________, Memorandum to T.P. O'Farrell. Subject: Volatile Emissions of RCRA Priority 1 Organics in Sewers. June 3, 1985.

3. __________, Memorandum to T.P. O'Farrell. Subject: Follow-up Estimations of Removability and Impact of Priority 1, 2, 3 and Tier 2A RCRA Toxics. September 13, 1985.

4. __________, Memorandum to T.P. O'Farrell. Subject: Estimation of Removability and Impact of RCRA Toxics. September 26, 1985.

5. Dixon, Gina and Bremen, Bill (Versar), Memorandum to Forest Reinhardt. Subject: Technical Background and Estimation Methods for Assessing Air Releases from Sewage Treatment Plants. October 11, 1984.

6. Petrasek, A.C., et. al., "Removal and Partitioning of Volatile Organic Priority Pollutants in Wastewater Treatment." Presented at the Ninth U.S.-Japan Conference on Sewage Treatment Technology, Tokyo, Japan, September 1983.

7. Strier, Murray P., Memorandum to the Record. Subject: Response to Comments from Chemical Manufacturers Association (CMA) of August 17, 1983 to Proposed Effluent Limitations for the Organic Chemicals and Plastics and Synthetic Fibers Category (FR Vol. 48, No. 55, March 21, 1983). May 17, 1985.

8. __________, Memorandum to the Record. Subject: Significant Consequences of Telephone Conversation with Dr. Kincannon of Oklahoma State University Regarding his Bench-Scale Activated Sludge Reactor Studies. May 7, 1985.

9. E.C. Jordan Co., Priority Pollutants in Publicly Owned Treatment Works - Summary Report. Prepared for U.S. Environmental Protection Agency, January 1984.

10. DeWalle, F.B., et. al., Presence of Priority Pollutants in Sewage and Their Removal in Sewage Treatment Plants. Prepared for the U.S. Environmental Protection Agency.

11. Weber, W.W. and Jones, B.E., Toxic Substances Removal in Activated Sludge and PAC Treatment Systems. Draft Report. Cincinnati, Ohio: Water Engineering Research Laboratory, U.S. Environmental Protection Agency, 1985.

12. Unpublished EPA/WERL research project performed at Purdue University.

13. Petrasek, A.C., and Kugelman, I.J., "Metals Removal and Partitioning in Conventional Wastewater Treatment Plants," Journal of the Water Pollution Control Federation, Vol. 55, p. 1183 (1983).

14. Berglund, R.L., Whipple, G.M., Hansen, J.L., Alsop, G.M., Siegrist, T.W., Wilker, B.E., and Dempsey, C.R. "Fate of Low Solubility Chemicals in a Petroleum Chemical Wastewater Treatment Facility." Presented at the National Meeting of AICHE, August 1985.

15. Lucas, A.D., Health Hazard Evaluation Report No. HETA 81-207-945, Metropolitan Sewer District, Cincinnati, Ohio. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981.

CHAPTER 4

ADDITIONAL REFERENCES

Bishop, Dolloff F., Role of Municipal Wastewater Treatment in Control of Toxics. EPA-6009/D-82-360; NTIS PB-152447. September 1982.

Environ Corporation, "Characterization of Constituents from Selected Waste Streams" (listed in 40 CFR 261). Washington, DC: U.S. Environmental Protection Agency, August 3, 1984.

Geating, John, Literature Study of the Biodegradability of Chemicals in Water. Vol. I. EPA-600/22-81-175/176; NTIS PB 82-100843. Cincinnati, Ohio: Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency, October 1981.

Hannah, Sidney A., et al. "Comparative Removal of Toxic Pollutants by Six Wastewater Treatment Processes." Cincinnati, Ohio: Water Engineering Research Laboratory, U.S. Environmental Protection Agency, April 1985.

Kieslich, Klaus, Microbial Transformations of Non-Steroid Cyclic Compounds. Germany: John Wiley & Sons, Thieme Publishing, 1976.

Kirsch, E.J., et al., Fate of Eight Organic Priority Pollutants in Biological Waste Treatment. Draft Report. Cincinnati, Ohio: Water Engineering Research Laboratory, U.S. Environmental Protection Agency, 1985.

Booz Allen & Hamilton, Sludge Management Project Model Risk Analysis Exercise, Municipal Sludge Generation and Distribution: Nationwide Estimates. Prepared for U.S. Environmental Protection Agency Sludge Task Force, January 18, 1983.

Blankenship, Eric (JRB Associates), Memorandum to Paul Storch. Subject: POTW Pollutant Removal. September 8, 1981.

Camp Dresser & McKee, A Comparison of Studies of Toxic Substances in POTW Sludge. Prepared for U.S. Environmental Protection Agency, August 1984.

U.S. Environmental Protection Agency, Interim Report of the EPA Sludge Task Force. Washington, DC: U.S. Environmental Protection Agency, August 1983.

__________, Development Document for Proposed Effluent Limitations Guidelines and New Performance Standards for the Organic Chemicals and Plastics and Synthetic Fibers Industry. February 1983.

Strier, Murray P., Memorandum to the Record. Subject: Evidence that Air Stripping Rates of Toluene Exceeds it Biological Oxidation Rates in Aeration Basins from Three Independent References. May 24, 1985.

U.S. Environmental Protection Agency, Office of Water Program Operations, State and Local Pretreatment Programs. Vol. I. EPA-430/9-76-017. Washington, DC: U.S. Environmental Protection Agency, January 1977.

________, 304(g) Guidance Document; Revised Pretreatment Guidelines. Vol. I. Washington, DC: U.S. Environmental Protection Agency, October 1981.

Tabak, H.H., et al., "Biodegradation Studies for Predicting the Environmental Fate of Organic Priority Pollutants," in Proceedings of the AOAC Symposium. 94th AOAC Meeting, 1980.

Versar, Inc., Physical-Chemical Properties and Categorization of RCRA Wastes According to Volatility. Draft Report. Cincinnati, Ohio: Industrial Environmental Research Laboratory, U.S. Environmental Protection Agency, April 30, 1984.

VanZile, L. and Long, D., "Computer Management of Industrial Wastes," Operations Forum, Vol. 2, No. 7, July 1985.

Booz Allen & Hamilton, Description and Comparison of Municipal Sewage Sludge Generation and Disposal Data Bases. Prepared for the U.S. Environmental Protection Agency, July 26, 1982.

Time, Henry and Leblanc, Pauline, Permits Division, Region V, Memorandum to Glenn Pratt, Chief, Permits Section, Region V, U.S. Environmental Protection Agency. August 17, 1984.

Williams, John, Site Director, Philadelphia Integrated Environmental Management Project, Memorandum to Richard Kinch, Executive Director, Pretreatment Implementation Review Task Force, July 30, 1984.

Haggert, B. and Harkov, Ron, Office of Science & Research, New Jersey Department of Environmental Protection, Untitled Report.

Pratt, Glenn, Chief, Permits Section, Region V, Memorandum to Joseph Paisie, Chief, Technical Analysis Section, ARB, U.S. Environmental Protection Agency. August 29, 1984.

National Fire Protection Association, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids, 1984. NFPA 325M-1984.

CHAPTER 5

LIST OF REFERENCES

1. U.S. Environmental Protection Agency, Effluent Guidelines Division, *Fates of Priority Pollutants in Publicly Owned Treatment Works*. Final Report. EPA-440/1-80-303. Washington, DC: U.S. Environmental Protection Agency, September 1982.

2. ________, *Addendum: Assessment of Impacts of Industrial Discharges on Publicly Owned Treatment Works*. February 25, 1983.

3. Science Applications International Corporation, *AMSA Survey Results*. Prepared for the U.S. Environmental Protection Agency, Office of Water Regulations and Standards, August 1985.

4. Olson, C.R. and Shaeffer, D., *Mutagenicity Testing of Industrial and Municipal Effluents by the Illinois Environmental Protection Agency*. Springfield, IL: Illinois Environmental Protection Agency, 1983.

5. Henry, Timothy, Permits Section, Region V, Personal Correspondence. August 22, 1985.

6. Tedder, Steve W., Head, Technical Services Branch, State of North Carolina, Department of Natural Resources and Community Development, Personal Correspondence. August 13, 1985.

7. State of Florida, Department of Environmental Regulation, *Bioassay Testing Program, June 1979-September 1982*. April 1983 and October 14, 1983.

8. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Emissions Data and Model Review for Wastewater Treatment Operation*. Draft Technical Note. August 1985.

9. ________, Office of Policy, Planning and Evaluation (IEMD), *Evaluation of the Performance of the Dispersion Model SHORTZ for Predicting Concentrations of Air Toxics in the U.S. Environmental Protection Agency's Philadelphia Geographic Study*. Draft Report. February 8, 1985.

10. Versar, Inc. and American Management Systems, *Hazardous Air Pollutants: A Preliminary Exposure and Risk Assessment for 35 U.S. Counties*. September 1984.

11. U.S. Environmental Protection Agency, *Cost and Benefits of Reducing Lead in Gasoline*. Final Regulatory Impact Analysis. EPA 230-05-85-006. February 1985.

12. Industrial Economics, Inc., *Cost-Effectiveness Analysis of Strategies to Reduce Human Health Risk in Philadelphia*. May 1985.

13. U.S. Environmental Protection Agency, Office of Water, *Volatilization of Organic Compounds from Municipal Sewage Treatment Plants, Overview of IEMD Findings*. Briefing Paper. September 1985.

14. __________, Office of Ground Water Protection, *Overview of State Ground Water Programs Summaries*. Vol. I. March 1985.

15. __________, Office of Water Program Operations, *NEEDS Survey Report to Congress, User's Manual*. EPA-430/9-84-011. 1984.

16. __________, Office of Water Regulations and Standards/Wastewater Solids Criteria Branch, *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge*. July 1985.

CHAPTER 6

LIST OF REFERENCES

1. Weddle, Bruce, Memo to OSW Senior Staff. Subject: Summary Report on RCRA Activities. July 1985.

2. Levy, Steve, Permits and State Programs Division, Office of Solid Waste, U.S. Environmental Protection Agency, Personal Correspondence.

3. Science Applications International Corporation, *AMSA Survey Results*. Prepared for the U.S. Environmental Protection Agency, Office of Water Regulations and Standards, August 1985.

4. U.S. Environmental Protection Agency, Office of Solid Waste, Permits and State Programs Division, *Authorization of State Hazardous Waste Programs*. September 1985.

5. Hall, Ridgeway, M., et al., *Hazardous Waste Handbook*. 5th Edition. Government Institutes, October 1984.

6. Hanmer, Rebecca, Director, Office of Water Enforcement and Permits, Memorandum to Regional Water Management Division Directors and NPDES State Directors. Subject: Local Limits Requirements for POTW Pretreatment Programs. August 5, 1985.

7. Notzon, Ned, Director, Monitoring and Data Support Division, Memo to Ed Conlon, Acting Director, Office of Water Regulations and Standards. Subject: Regions and States Use of Bioassays. September 1985.

8. JRB Associates, *Draft Summary of Pretreatment Audit Reports*. Prepared for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, December 1984.

9. U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, *Pretreatment Implementation Review Task Force Final Report to the Administrator*. January 30, 1985.

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